SCIENTIFIC MISSION

TO

INDIA AND HIGH ASIA.

VOLUME IV.

RESULTS

OF A SCIENTIFIC MISSION TO

INDIA AND HIGH ASIA,

UNDERTAKEN BETWEEN THE YEARS MDCCCLIV. AND MDCCCLVIII.,

BY ORDER OF THE COURT OF DIRECTORS OF THE HONOURABLE EAST INDIA COMPANY

BY

HERMANN DE SCHLAGINTWEIT-SAKÜNLÜNSKI,
ADOLPHE, AND ROBERT DE SCHLAGINTWEIT.

WITH AN ATLAS OF PANORAMAS, VIEWS, AND MAPS.

VOLUME IV.

LEIPZIG: F. A. BROCKHAUS.
LONDON: TRÜBNER & CO.
MDCCCLXVI.

METEOROLOGY OF INDIA

AN ANALYSIS

OF

THE PHYSICAL CONDITIONS OF INDIA, THE HIMÁLAYA, WESTERN TÍBET, AND TURKISTÁN

WITH NUMEROUS TABLES, DIAGRAMS, AND MAPS.

BASED UPON OBSERVATIONS MADE BY MESSRS. DE SCHLAGINTWEIT EN ROUTE AND COLLECTED FROM VARIOUS STATIONS ERECTED DURING THEIR MAGNETIC SURVEY, AND INCREASED BY NUMEROUS ADDITIONS CHIEFLY OBTAINED FROM THE OFFICERS OF THE MEDICAL DEPARTMENTS.

BY

HERMANN DE SCHLAGINTWEIT-SAKÜNLÜNSKI.

FIRST PART:

DISTRIBUTION OF THE TEMPERATURE OF THE AIR, AND ISOTHERMAL LINES, WITH CONSIDERATIONS ON CLIMATE AND SANITARY CONDITIONS.

LEIPZIG: F. A. BROCKHAUS. LONDON: TRÜBNER & CO.

MDCCCLXVI.

TO

H. R. H. ALBERT EDWARD,

PRINCE OF WALES.

Your Royal Highness's own travels in various parts of the great British Empire, and celebrated authorities in Natural Philosophy and Meteorology at home, have made Your Royal Highness fully alive to the scientific importance of the Study of Climate. And the more we learn to separate local disturbances from general causes, the more apparent and valuable also its application to the practical conditions of life shall become.

Such considerations, encouraging as they are, have made me feel, however, at the same time, the greater difficulty in presenting a work which should not be unworthy of the expectations which Your Royal Highness so graciously expressed when conferring upon me the distinction of accepting my dedication.

The permission to adorn my work with the name of Your Royal Highness as patron is a most glorious recompense for the labour and toil undergone in the course of my researches; and it will prove—which is a not less important consideration—a mighty promoter of science, as it will undoubtedly call forth many a new contribution to Meteorology from even beyond the borders of the Indian Realm.

With profound respect

Your Royal Highness's

most obedient Servant

Jägersburg, Oct. 1865.

THE AUTHOR.

PREFACE.

In consequence of my obtaining from India new observations, of which many within the last two years only, the publication of this volume was materially delayed; whilst at the same time they presented welcome materials for testing theoretically and practically the results which we had obtained from our travels and our own registers.

Also the unexpected modifications resulting for some of the principal conditions of the distribution of heat—such as the rise of the thermal equator in the very height of the rainy season as far north as 32° degrees of latitude, the remarkable difference in the decrease of temperature with latitude between autumn and the cool season; or, as in High Asia, the unexpected deviation in many regards from what I formerly had occasion to observe in the Alps in reference to the thermal conditions of the borders, valleys and glaciers—are other elements which must be alluded to as having required exceptional time and labour.

The provinces are brought into ten groups for India, and four for High Asia. In the topographical details preceding the different groups it was occasionally unavoidable to allude to causes of the same

nature being of influence here and there, but so it had to be done for making the more apparent what is analogous and what is not.

The elaboration is detailed in the introductory part of this volume; the methods of deducing the means had to be analysed with special care, the comparison of previous publications with the numerical details of the original registers now in my hands showing but too often a quite arbitrary combination of hours. Attention must be drawn in this regard to the combination of Sunrise and Four o'clock in the afternoon (SR. and 4^h P.M.) by the plain mean of which a very favourable daily mean is obtained from two hours only; if 10^h A.M. is added the variation also of pressure and wind becomes sufficiently well defined. For showing the daily range together with the calculation, or the final correction employed, the observation at sunrise and that of an hour in the afternoon are given besides the mean resulting; wherever the observers' registers allowed to do so Four o'clock P.M. was chosen for the afternoon. The original materials contained for every station a great deal more; the additional hours, though not used for the calculation, afforded many a data for the better defining the character of the climate.

Where the observations were not as detailed as usual, no decimals are added to the resulting means; the decimal 0·5 when dropped was not counted over. I was the more induced to adopt this rule since experience had shown me that most observers when estimating fractions of a degree have a slight tendency to read rather a little too high. Brackets are added where either the materials were incomplete in the registers, or where, as seen in the tabular arrangement of the results, one year only existed for a month, whilst several years could be combined for the other months.

The hourly variations in the daily and yearly period had to be given only for some stations. Next to these tables the comparison of the thermometrical scales has still to be mentioned; I gave it with so

much detail, following a special plan of the Indian Meteorological Committee, since in this form only it sufficiently saves all trouble in comparing data from continental works with Indian and Himalayan climate.

Insolation and radiation, though important also by their powerful influence upon the temperature in the shade, could be alluded to here only in reference to the principal modification: the difference resulting for dry and moist climate; in the next volume these observations and experiments shall be gone through in combination with the optical phenomena; a preliminary communication has appeared already in the Bulletin of the Munich Academy.

Special care had to be taken in reference to Hill-stations also in India proper; they are a matter of the greatest importance for the location of European troops. Besides the larger official papers, and labours like those of SYKES, HODGSON, and MACPHERSON, quoted in the meteorological literature, much information was obtained after our departure by correspondence, since so much had been done by government for ascertaining the sanitary conditions. Notwithstanding the difficulties of the protection of Europeans which will ever remain, at present already the advancement in the knowledge of climate and sanitary rules has shown from year to year a beneficial effect. The returns which have been issued from the Army Medical Department relating to the health of the European forces in India for 1862, show the deaths to have been only 25·68 per 1000, being nearly a third under the proportion of 1861. The mortality in the Madrás Presidency was 20·83 per 1000; Bombay 24·60; and Bengál (where the majority of the troops are quartered), 27·55. Informations obtained in the course of publication allow us to expect even 21 to 22 as the average for the year 1864 to 1865.

Cooperation was the more valuable in researches on Indian Meteorology as the present work is the first for which it is the special object. It therefore affords me great pleasure to draw attention here already to the contents of the Parliamentary Sanitary Reports which were called forth in 1859 by Lord STANLEY to whom, also personally, we are indebted from the beginning of our publications for important and various assistance.

In India a Meteorological Committee of the Asiatic Society of Bengál has recently been formed, a private support to this branch of science, originated by that same gentleman-like and personal interest which, in every regard, has made contributions from Indian residents a treasure for Europe.

The alphabet used for the transcription is added also in the present volume in a tabular form to the introductory part; in connection with the geographical glossary contained in the preceding volume I had occasion to explain the principle adopted.

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PART I.

THE OUTLINES OF CLIMATE AND THE VARIATION OF TEMPERATURE.

PART II.

THE THERMAL STATIONS OF INDIA.

PART III.

THE THERMAL STATIONS OF HIGH ASIA.

PART IV.

THE ISOTHERMAL PROFILES OF HIGH ASIA;
DECREASE OF TEMPERATURE WITH HEIGHT; AND CONNEXION WITH PHYSICAL PHENOMENA.

PART OF THE ATLAS IN SPECIAL REFERENCE TO VOL. IV.

Illustrations of the Meteorology of India and High Asia.

I. Temperature of the Air:

Plate No. 1.	Numerical Table of mean Temperature		for India
„ No. 2.	The Isothermal Lines of the Year . . .		and
„ No. 3.	The Isothermal Lines of the Seasons .		the Archipelago.
„ No. 4.	Stations of Isothermal Profiles of High Asia, General variation of temperature, and Chart of the Indian tropical sanitaria.		

Also the plates of panoramas and views till now published in the Atlas, twenty-nine in number, had repeatedly to be quoted in reference to their meteorological features.

ERRATA AND ADDENDA.

The numerical table of the mean temperature of India and the Archipelago, Plate No. 1 of the meteorological part of the Atlas, had to be printed some time before the greater part of the stations in the text and various corrections and additions more recently obtained therefore came too late to be applied in the table. The errors referring to this table alone follow separately.

Page 40 line 2, *for* two systems *read* a system
„ 41 „ 10, *after* in reference to the variability *add* when the proportions of the coordinates are fixed
„ 48 „ 21, *for* plate 3 *read* plate No. 4
„ 115 „ 20, *for* groups *read* crops
„ 117 „ 30, *for* Bólelah *read* Bóleah
„ 197 and table Group 2 Barrakpúr, Dec. to Febr., *for* 69·6 *read* 68·9
„ 257 and table Group 3 Lăkhnău, March to May, *for* 71·6, *read* 85·8; June to Aug., *for* 89·0, *read* 87·2; Year, *for* 76 *read* 78·8
„ 285 line 5, *for* 1844 *read* 1854
„ 316 title of page, *for* Sisabáldi *read* Sitabáldi
„ 325 „ „ „ *for* Bandelkánd *read* Bandelkhánd
line 1, *for* Káladghi *read* Kăládghi
„ 337 title of page, *for* Himálaya *read* central Himálaya
„ 494 line 3, *for* lat. 28° 38′ *read* lat. 29° 38′
„ 512 station Dalhousie, March to May, *for* (60·6) *read* (60·7)
„ 507 title of page, *for* Himálaya *read* northwestern Himálaya
„ 529 station Kánam, Sept. to Nov., *for* 84·8 *read* 54·8
„ 532 station Skárdo, Dec. to Febr., *for* 35 *read* 34·7

Numerical Table, Plate No. 1
Group 2, station Chaiabásso, Jan. *for* 67·0 *read* 63.6. D. J. F., *for* 67·6 *read* 66·5. Year *for* 78·2 *read* 77·9
„ 3, „ Mozăfarpúr, J. J. A., *for* 84·7 *read* 84·6
Group 4, station Nakódar *to be added*: Febr. (61), D. J. F., 57·6. Year 75·2
„ 5, „ Rajkót, J. J. A., *for* 88·1 *read* 85·1. Year *for* 80·0 *read* 80·4
„ 6, „ Chikáldah, Latitude, *for* 22° 50′ *read* 20° 50′. New materials are *added* in the text, Vol. IV., p. 321.
„ 6, „ Kokonáda, *for* long. 12° 14′ *read* 72° 14′
„ 6, „ Samulkóttah, Year, *for* 77·0 *read* 76·7
„ 7, 1 „ Bíjapur, Year, *for* 81·7 *read* 81·0
„ 7, 1 „ Dharvár, S. O. N, *for* 71·2, *read* 74·6 Year, *for* 74 *read* 74·8
„ 7, 1 „ Kádapa, D. J. F., *for* 76·7 *read* 76·9
„ 7, 1 „ Kăládghi, Year, *for* 78·8 *read* 78·6
„ 7, 1 *for* Pháltan *read* Phăltan
„ 7, 2 *for* Manantsădi *read* Manantvádi
„ 9, station Kolómbo, S. O. N., *for* 78·4 *read* 79.4
„ 9 „ Máteli, Year, *for* 77·0 *read* 76·0
„ 9 „ Trinkonomalí, M. A. M., *for* 82·8 *read* 84·8. Year, *for* 83·0 *read* 83·5
„ 10 „ Banjuvángi, D. J. F., *for* 80·0 *read* 80·1 J. J. A., *for* 78·4 *read* 79·1 S. O. N., *for* 80·8 *read* 80·0 Year, *for* 79·8 *read* 79·9
„ 10 „ Batávia, J. J. A., *for* 78·7 *read* 79·0 Year *for* 79·0 *read* 79·1
„ 10 *for* Sarăvak *read* Sarăvak
"Remarks" line 8, *for* Thónghu *read* Tónghu

Plates Nos. 1 and 4. In reference to the isothermal line of 73° Fahr., new data from Eastern Bengál and Assám had allowed me better to define its form and had altered it in the eastern part of the isothermal chart. In the isothermal lines of India, Plate No. 2, it sinks, from 35° of lat. N. on the western border, to 29° of latitude near the eastern border. More recent materials showed it to descend there nearly a degree lower, as represented on Plate No. 4, together with the numerical details of High Asia.

ALPHABET USED FOR TRANSCRIPTION.

a (ā ă a̱ ã); ä; b (bh); ch (chh); d (dh); e (ĕ ē ẽ); f; g (gh); h; i (ī ĩ); j (jh); k (kh), k͟h; l (lh); m; n; o (ō õ), ö; p (ph); r (rh); s; sh; t (th); u (ū ũ), ü; v; y; z.

RULES OF PRONUNCIATION.

The system of the transcription adopted is explained in Vol. I., pp. 66—70, *and Vol. III., pp.* 139—160.

Vowels.

1. a, e, i, o, u, as in German and Italian.
2. ä, ö, ü, as in German.
3. Diphthongs give the sound of the two component vowels combined. Diæresis is marked by the accent falling on the second of the two vowels.
4. - above the vowel makes the vowel long.

   In general we considered it unnecessary to add this sign when the accent coincided with it and the omission would not influence the correctness of the pronunciation.

   Short vowels are not separately distinguished.
5. ˘ above a and e (ă ĕ) is a sign of imperfect phonetic formation, similar to the open *u* in *but*, and *e* in *herd*.
6. - below a indicates the deep sound, like *a* in *wall*.
7. ˜ above a and o indicates a nasal sound, like *a* and *o* in the French words *gant* and *son;* also ẽ, ĩ, and ũ had to be introduced for marking the nasal sound of e, i, and u; in the nasal diphthongs aũ and aĩ, we make the sign over one only, though both have the nasal sound.

Consonants.

1. b, d, f, g, h, k, l, m, n, p, r, s, t, are pronounced as in German and English [the variations occurring in the pronunciation of g, and h (in English) excepted].
2. h, after a consonant is an audible aspiration, except in ch, sh, and k͟h.
3. ch, as in English *(church)*.
4. sh, as in English *(shade)*.
5. k͟h, as ch in German *(hoch)*.
6. j, as in English *(just)*.
7. v, as the *w* in German *(Wasser)*, being different from *v* in *very*, and *w* in *water*.
8. y, as *y* in the English word *yes*, or *j* in the German *ja*.
9. z, soft, as in English.

Accents.

′ marks the syllable on which the accent falls, whether the syllable be long or short.

Alphabetical Registers.

In our alphabetical registers the letters follow in the order of the alphabet, irrespective of the signs attached to them.

GENERAL REMARKS.

The measurements of heights and distances are given in English feet, the miles also are English.

All the heights are absolute, referring to the level of the sea.

The latitudes are North unless separately marked by S as southern; the longitudes are referred to the meridian of Greenwich. Adopted longitude of the Madrás Observatory: 80° 13′ 56″ East Green.

The readings of the thermometer are given in Fahrenheit.

PART I.

THE OUTLINES OF CLIMATE

AND

THE VARIATION OF TEMPERATURE.

ERRATUM.

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p. 569 line 17 for 9,100′ read 8,900′.

I. ARRANGEMENT OF THE METEOROLOGICAL VOLUMES.

A. Temperature, Moisture, Rain. *B.* Pressure, Wind, Optical Phenomena, Physical and Chemical Experiments.
Climate in general described, together with the details respecting Temperature.

An analysis of the physical and chemical qualities of the atmosphere, experiments and details concerning the heating power of the Sun, and its modification in acting upon solid or liquid surface—such are the elements from which natural philosophy in most of the general works on meteorology has started for facilitating the interpretation of what we observe.

For the observations and materials collected during the travels from 1854-58 I preferred beginning in this volume with the characteristic of climate and the observations about temperature, moisture, and rain. For India and the countries to the north of it, where a region of excessive heat is followed next by that of excessive height, such materials the better direct the attention to unexpected questions as to the principal causes. Wind and barometric pressure, optical phenomena, and physical and chemical experiments, shall be the subjects of the next volume.

Temperature is the active power, the *force vive* of the meteorological phenomena, and the tables introduced by a *descriptive characteristic of climate* can be connected, at the same time, with the modifications of cultivation and settlement—with the habits and manners, even the character of the inhabitants. By its influence upon vegetation temperature is not less important for the types of foreign scenery. Also the great variety of climates, if we consider the changes from Ceylon up to the Pănjáb, is in favour of describing them in the first part of the meteorological researches; it is

an introduction for the European reader—it is the key to many a question for the intelligent native; and, for the author's memory, I found these outlines to be the best reanimation of the recollections, teaching one fully to appreciate the influence of such *numeric* variations, which otherwise might but too easily appear indifferent.

In Ceylon and along the southern coasts the climate is not excessively hot, though steamy and close—the eternal spring of the tropics for those who never have been there. In the Pănjáb already the difference between absolute extremes in the course of the year amounts to 90° Fahr., and the sea breeze of the tropical coasts for many a day has no other substitute here than the breaking down of a hot wind with sunset in spring and summer, and the morning ice upon unprotected sheets of water in the cool season. At first the climate of India might be thought not to show very many different features to describe as long as height remains excluded. Nearly all its surface is within the tropics; it is surrounded by seas on two of its sides, and along the third it is separated from the continental region of Asia by the highest chains of our globe; here, however, the periodic changes of the monsoons and the power of a tropical sun are combined in their action upon climate. Besides, we must not forget the distance of the limits: it amounts, from Ceylon to the Pănjáb, to 30 degrees of latitude and to 25 degrees of longitude, from Kábul to the western end of the Himálaya above Assám being fully as far as from Gibraltar to Greece.

II. METEOROLOGICAL MATERIALS.

Manuscripts of Observations during our Travels. Panoramas and views quoted when illustrating also meteorological details.

Previous Meteorological Registers. Asiatic Society of Bengál; Col. Sykes; Dr. Lambe.

Meteorological Official Manuscripts. Hugh Macpherson's Mediation. Materials contained in the thirty-eight volumes. Dahse's assistance in calculating. My abstract of means published in the Transactions of the Royal Society. Number of stations.

Parliamentary Reports on the sanitary state of the Army in India. Begun by Lord Stanley. Important contributions by Glaisher, Duncan Macpherson, Martin, Pearse, Rooke, Sutherland. Incomplete means.

Official Materials, printed in India. Selection from the Reports of Government. Duncan Macpherson, Balfour. —Himálaya.

Scientific Journals and Local Publications of India. Alphabetic List. I. Temperature. II. Radiation, Mirage, Evaporation, Snow line. III. Rain. IV. Wind.

MANUSCRIPTS OF OBSERVATIONS DURING OUR TRAVELS.

Great is the variety of details preying upon a traveller's mind simultaneously whilst crossing large tracts of land novel to him and partly unexplored by previous observers. Finally, when he arrives at thinking over his impressions and at the heavier task of working up his manuscripts, he would be bewildered by the multiplicity of facts, had he not followed a certain plan in his books. Thus, in travelling already much assistance can be obtained from keeping the writings as subdivided as possible. I had made it our rule to use one general book at a time, but its sheets were numbered, and a detailed preliminary division of space had been made for the various branches. As an additional modification apparently of minor importance, but useful, I can recommend the English practice of writing manuscripts on one page only; this allows one to cut off what, in a final arrangement, he may wish to place elsewhere, without its being requisite to make subdivisions and quotations; and such manuscripts can easily be brought into any systematic form the subjects may require.

Our *manuscripts of observations* are bound together at present from forty-six volumes, two of which, the relics of our poor brother Adolphe, only reached us January 10th 1862,

from Káshgar, where he had been killed; Vols. 17 to 24 contain the meteorological researches of ourselves and our establishments.

These forty-six volumes of manuscripts of observations are: 1. Itineraries. 2, 3, 4. Routes and Route-books. 5. Comparison of instruments, and corrections. 6, 7, 8. Topography and trigonometrical measurements. 9—12. Astronomical determinations of latitudes and longitudes; magnetic observations. 17, 18, 19. Climate in general; temperature. 20, 21. Carbonic acid of the atmosphere; rain; dew; height of clouds; electricity; ozone; optical phenomena; glaciers. 22, 23, 24. Temperature of rivers; of the ground at various depths. 25. Physical geography of the sea. 26. Sources and thermal springs. 27—30. Geological researches. 31, 32. Geological collections. 33—36. Hydrography of rivers; depth and temperature of subterranean water. 37, 38, 39. Ethnography, measurements; glossaries. 40. Ethnographical and zoological collections and observations. 41, 42. Botanical and Colonial details in general. 43. Official letters and reports. 44, 45, 46. Adolphe's posthumous papers of observation.—A printed copy of a detailed index has also been added to our official communications presented in 1860 to the India Office and to the governments of India.

During our journeys meteorological instruments were left for continued corresponding observations wherever the occasion presented itself.

In India we enjoyed at various stations (as mentioned in detail in the alphabetical lists) the private assistance of the residents, ready to undergo the trouble of careful observations.

In the Himálaya and in the regions to the north of it, as soon as the zone of sanitary Hill-stations was passed, every observation had to be made not only with our own instruments, but we also had to leave observers behind with them. Amongst these I particularly name my assistant Lieut. Adams for Síkkim and north-eastern Assám; the native doctor Hărkíshen for the central parts of the Himálaya and Ladák; and Mr. Monteiro, the zoological collector, for the western Himálaya and Kashmír. In reference to meteorological registers my particular attention was directed in every new region properly to define in the first instance the laws of periodic variations, so important for the deduction of any kind of meteorological results.—The instruments used and their description, as far as new modifications applied are concerned, shall be added in conclusion.

The *panoramas and views*, 750 in number[1] with those of my brother ADOLPHE, may be also mentioned, materially facilitating the illustration of the phenomena of physical geography. During the progress of the publication, therefore, the plates of the atlas were purposely selected so as to show a great variety of scenery; and in consequence aspects drawn from nature can now be quoted in most instances in connexion with the climate of the various provinces and groups.

PREVIOUS METEOROLOGICAL REGISTERS.

These materials are limited for India to a comparatively narrow space of time; but also for other parts of the tropics our knowledge of climate in the form of positive data is not very ancient. In India, soon after the appearance of Humboldt's standard works on isothermal lines, some of the men to whom we owe the foundation and the progress of the Asiatic Society in India had directed their attention also to the definition of climate.[2] The observations remained limited for some time to a few places only. Col. H. W. SYKES first published more extensive researches, particularly rich in details about the Dékhan;[3] besides the scientific results they presented in themselves they were also of great importance in directing the attention of Government to the relations connecting meteorology with the various questions of military and civil settlements, and soon after his reception into the Court of Directors the plan for an extensive series of meteorological observations to be distributed all over India, in charge of the medical establishment, was put in execution.[4]

Dr. LAMBE's Register in the Asiatic Society's Journal for 1852 gives the monthly means for ninety-five stations;[5] they are most carefully collected, but, as Dr. LAMBE himself says, in his introductory remarks, many of them may be considered too warm by

[1] The Atlas of 100 plates will contain, besides the panoramas and views, about 20 plates more of physical and geographical maps. At present, four volumes of the nine being completed, 44 plates have appeared. A general register will indicate the final systematic arrangement.

[2] These stations, so carefully collected by DOVE in Berlin and SCHMIDT in Jena, I have not failed to add, for comparison with the more recent data.

[3] See "Literature" and "Group of Stations."

[4] Marshal RANDON, the minister of war in France, has recently decided that analogous observations shall be made in the French hospitals in Algeria. The advice for the execution, and the tables to be used, are put together by M. GRELLSES.

[5] Communicated by Col. SYKES to the British Association in 1852; also contained in DOVE's "Non-periodical variations of temperature," Part IV., Berlin Academy, 1853.

as much as 2° to 4° Fahr. This is particularly the case, as I had occasion to find from comparison with my more detailed materials, in the central and north-western regions, where the daily variation is greater, and where in consequence, an improper combination of hours produces a deviation from the true mean which is the more considerable. The tables sent in to Dr. LAMBE had not unfrequently been based upon the arithmetical mean of Sunrise, 10′ Noon, 2, 4, Sunset: in consequence the result was a higher temperature even than the mean for the "day" only (since the comparatively cool morning hour 8 A. M. is not even included); and his values differ considerably from the mean of the 24 hours, particularly for the regions and periods of vivid nocturnal radiation.

A difference of "a few degrees" is of much greater importance, when compared to the effect of space on the globe, than might perhaps at first be expected. A glance at the isothermal maps shows it plainly enough, if we take into consideration how little altogether the *numerical* values vary in some regions and particularly in some seasons.

METEOROLOGICAL OFFICIAL MANUSCRIPTS.

It was the more important for me that I obtained a very great number of official meteorological Registers in the full detail of the original observations. From various civil and military stations they could be procured during our travels, but by far the greatest part I obtained from the Medical Board in Calcutta, now succeeded by the office of the Principal Inspector-General of Health, Dr. McCLELLAND.

For these *meteorological manuscripts* I am particularly indebted to the proposals and the mediation of Dr. MACPHERSON. From 1851, after Dr. LAMBE's examination of the papers, the sending in of meteorological registers to the medical board went on, but they arrived very irregularly and remained deposited in one general repository; in 1857 they were handed over to me; also for some of the next years registers were sent to me to Europe.

My first impression on opening the huge boxes at home was not a favorable one; the only thing which could at first be done was to form preliminary groups according to the tint and size of paper; within these groups further distinctions could be made, finally leading to a topographical and chronologial arrangement. Then, however, materials before me presented themselves very complete indeed, notwithstanding the vast surface they included; they now form a series of thirty-eight folio-volumes

of manuscripts,[1] to which became added one volume of index of contents and general observations; the number of these stations is 197.

A careful control, in most cases from a personal examination of the observations, the localities, and the mode of putting up the instruments, also enables me to state, that in general the observations of the medical officers are perfectly satisfactory[2] as to the numerical elements of temperature. In some cases the zeal of the observers, particularly where native assistants had to be employed, might have been greater; in others the selection of the place for putting up the instruments (so that for all hours of the day disturbing local influences remained as much as possible excluded) was not made with proper care; but in general the errors were not important; in but few cases had I to leave out one or the other month (in consequence of the thermometer's becoming affected by direct or reflected influence of the sun); occasionally a station had to be excluded completely; in the north-west provinces and in the Pănjáb, where the climate is more variable, greater care was necessary to select well the materials; in Bengál, for instance, where anomalies are less frequent, irregularities of the observation sooner appear as such.

If the month was not complete, the mean was introduced, if not more than one-third was wanting; if the days wanting were not equally distributed over the month, and if they were left out at the beginning or the end of the month, a correction was applied deduced from the formulæ for completing deficient periodic variations.[3] Also some of Dr. Lambe's means I could still correct in this respect from the materials I had obtained at Calcutta.—In the formation of decimal fractions five, when dropped, had not been counted over.—Where only entire degrees had been read off, the means also remained limited to entire degrees, unless the very great number of hours within the day, or similar favourable modifications, allowed one the better to define the decimals from partial daily curves.

[1] Meteorological and Magnetic Observations in India and the Himálayas, chiefly by the Officers of the Medical Department in India, and by several Gentlemen of the Civil and Military Service. Vols. 1 to 38; collected 1854 to 1858.

The distribution of the stations, as quoted in the course of this volume, is the following:

1, 2. Bombay, Kolába observatory. 3. Málabar coasts. 4 and 5. Ceylon. 6. Tenásserim, Síam. 7. Southern Karnátik. 8, 9. Koromándel coast, Bay of Bengál. 10. Maissúr, Dékhan. 11 to 14. Bengál. 15 to 20. Assám, Khássia Hills, Eastern Dependencies of Bengál. 21 to 27. Hindostán and NW. Provinces. 28 to 32. Pánjáb. 33. Rajputána. 34, 35. Síkkim, Nepál, Kamáon. 36. Gărhvál. 37. Sĕrmór. 38. Chámba, Márri. 39. Detailed general Index.

[2] For the hours of observation used, see "V., Calculation of the daily mean."

[3] See the considerations about "The daily and yearly periods of Temperature," p. 44.

The correction of the zero point was applied directly wherever traceable; in an average $^1/_2$° Fahr. can be considered as its mean value.

The *observers* will find their names[1] mentioned in due acknowledgement together with the period of their work.

For large military stations, where not unfrequently more than one series of observations was made independent of another, I generally preferred selecting one made with particular care to taking the mean of all of them.

The arithmetical *means* of the hours[2] I had recalculated for all the elements of my horary combinations, such as SR, 4h. P. M., min., max., &c. Though most of the arithmetical means were found correct, the revision also showed occasional errors, particularly in the stations were native medical assistants had to superintend the abstracts.

The materials contained in these papers were not limited to the *temperature* only; also the reading of a *wet bulb* thermometer and the thermometer exposed to the *sun's rays* were frequently added, and quite generally the quantity of *rain* and the direction of the *wind* were observed everywhere; the *ombrometrical data* I even obtained from many a station through the revenue offices; as will be seen later, this materially assisted me both in controlling as well as in obtaining new data about the quantity of rain.

Barometrical observations had to be used with precaution, though I found them very often in the official papers. It was unavoidable that frequently barometers which had to make so distant and difficult journeys to their places of destination had become effected by air getting in.

Finally the "*state of the weather*," including many a valuable detail about exceptional phenomena, such as storms, hail, meteors, was added everywhere, and I did not fail to profit in the course of my researches by these materials. Also the periodical press of India, following the example of the late Dr. Buist, had not failed to direct attention to such phenomena, which, if unexpected, I could generally trace to independent sources, confirming each other;[3] as to the ordinary description and comparative

[1] The initials (frequently very indistinct) and the titles I left out, as it would have been too long to enter into official details.

[2] The *combinations* for forming the means of the day were generally wrong or arbitrary throughout.

[3] For this purpose I had taken with me to Europe the last volumes of Calcutta, Bombay, Madras, Dehli, and Lahór papers, and had them carefully gone through by a clerk, Mr. Dingel.

characteristic of the weather in general, it had to be used with precaution. But too frequently a terminology of exaggeration, such as "more heavy rains than ever before," "unusually hot season," is seen repeated every year nearly on the same day. The vague character of such estimations is still materially increased by the circumstance that even the same individual is not equally affected every year by the same temperature, and that in India particularly climate has an apparent tendency to become worse with time for every one of the European residents, even if not becoming precisely hotter or cooler.

The manuscript materials generally did not include those of the year 1851; they were no longer at hand at the medical board when I came, as they had been given over to Dr. LAMBE. Therefore in but few instances could the year 1851 be given in the same form as the others, and in the application of a correction without the details I should have been the more unsuccessful, as there is every probability that the hours of observation are also not the same for all the stations.[1] For the littoral regions of climate with moderate daily variation, comparison showed, as was to be expected, that the deviations could be passed over. These stations will be found included in the results; for other stations the values are given only for comparison, some stations for which I had nothing to add I did not alter but left out;[2] whoever knows the doubtful value of isolated numbers will understand such a proceeding, I hope, and approve it.

Personal information obtained from the observers is contained in the details of the respective stations.

I could scarcely have succeeded in getting the necessary combinations worked out for so great a number of stations, had I not enjoyed the assistance of Mr. DAHSE, a man of unusual mental power in reference to arithmetical work. As his faculty, limited to this speciality, was quite exceptional, he had begun, when only a boy, to give performances; and after getting tired of this kind of life he settled in Berlin and offered his services as assistant in scientific work, and was also frequently employed by DOVE and ENKE. At a glance the mean of any number of data, even in complicated combinations, was deduced; and notwithstanding this rapidity he was perfectly trustworthy; never-

[1] Wherever I could recalculate I did so; and this will explain the occasional deviations from the numbers given by LAMBE, SYKES, and DOVE.

[2] As.: Amrítsăr, Bálasor, Bánda, Gugéra, Gurdáspur, &c.

theless he did not object to make re-calculations in a different form for control, when it was required. Also the counting of any number of objects was executed by him with equal facility as soon as he could see them separately, not so superposed over each other as partly to be concealed. When the materials of the thirty-eight volumes had to be taken to the bookbinder's, he wished, as an object of amusement, to be allowed to know how many sheets there were; it was sufficient for him to cast a look at every parcel along the edge where the folds were visible, to tell in a few minutes that the sum total was 7419, a number perfectly corroborated—additional pages of titles and registers being kept aside—when later for quotations and control of the progress of the work of calculation every sheet had got its number put on, and the sum total of the 38 books could be found.

He died of epilepsy at Berlin in 1860, about 34 years of age.[1] For my meteorological researches he had completed, besides the ordinary process of taking arithmetical means, two works particularly troublesome; the one was the reduction to the freezing point of the barometrical observations at the different stations[2] (the degrees of the thermometer being written at the side; as in the Parliamentary Reports, the atmospheric pressure at different stations cannot be directly compared): the next, more complicated still, was to deduce the resulting mean direction of the wind from the mechanical combination of the various directions observed.[3]

For putting the questions to him, even for writing down the results, he wanted assistance, and he himself remained perfectly indifferent[4] as to the nature of the object,

[1] I had repeatedly occasion to examine his skull, also together with anthropological friends; it showed nothing particular. He was a Jew, and his features allowed one to recognize the Semitic type. Perhaps the foldings of the brain might have shown some exceptional modifications, as the researches of Prof. Bischof have shown in several instances of unusual mental power.

[2] Those from the Parliamentary Reports I wanted (they are given there with "Temperature of the Mercury") I had reduced after Dahse's death by Mr. Hefner.

[3] Concerning the method employed see "Physic. Geogr. of the Alps," vol. I., p. 394. It will be detailed in volume V.; an arithmetical mean of different winds is in itself impossible.

[4] As a curiosity I must mention the report of a drama he made to me. That evening he had not come as expected; the following day, with his apology, he said, that in the theatre he had amused himself during the first act by counting the number of words beginning with an "S," but as this was too little work to fix his attention, he went on counting, but from that moment keeping those words separate where the "S" is followed by "T." When with me the next day he desired to try whether it agreed with the printed text I had in my library. The piece performed was Shakspeare's "Merchant of Venice," in Schlegel's translation; the subject as well as the players had remained unobserved by him.

a circumstance which not unfrequently made his talent less universally useful than otherwise might be expected, and enough remained to be done afterwards.

For India—the Himálaya and Tíbet not yet included—I have published the numerical elements for 208 stations in the Transactions of the Royal Society;[1] it was particularly pleasing to me to see these researches introduced by General SABINE, the President, so high an authority himself in every branch of physical geography. From communications obtained with usual liberality during my last visit to London, partly official letters addressed to me through the India office, partly printed Indian Records and Reports down to their most recent arrivals, I was enabled to increase the present edition of the Indian stations to 246. Those for High Asia are 32 in number.

PARLIAMENTARY REPORTS.

The *Parliamentary Reports on the Sanitary state of the Army in India,* a work most valuable also for many scientific questions, had been begun by Lord STANLEY, in 1859; it was published in 1863 in two volumes in folio and one volume in 8°. It would be too long to enter here into those details of statistics and medical topography we find here analysed, together with the practical military questions; in reference to meteorology for nearly every station some observations are added, and very valuable general articles are communicated in various parts of the work; I particularly quote:

GLAISHER, Dr. JAMES, Report upon the Meteorology of India in relation to the Health of Troops there stationed. Vol. I., p. 781-943.

MACPHERSON, Dr. DUNCAN, Inspector-General, Report on the Sanitary Conditions affecting all India. Vol. II., p. 622-660.

MARTIN, R. M., Remarks and Collected Facts on the Climate of India, on the Geological Features, and some tabulated Views of the Population. Vol. I., p. 503-526.

PEARSE, Dr., Principal Inspector-General, on the Sanitary State of the Indian Army, Madras Presidency, Vol. II., p. 601-621.

ROOKE, Dr., Principal Inspector-General, *do.*, Bombay Presidency, Vol. II., p. 911-918.

[1] These meteorological data were also received through Professor DOVE's mediation into the Berlin Academy's Monatsberichte, mathematisch-physic. class, 197-228, 1863. In the Munich Academy I had given an abstract, Bulletin, p. 332 to 241, 1863.

SUTHERLAND, Dr., Abstract of Returns made to the Questions issued by the Royal Commission. Vol. I.; local climates, p. 380-382.

An enumeration of the witnesses and the authors of the written replies would be too long here. The observers' names are mentioned at the respective stations. In reference to the *numerical* meteorological data, however, it is to be regretted that they are not complete enough to be traceable to the elements composing the mean. We have the same case here as in Dr. LAMBE's publication; the means had been sent in from an arbitrary combination of hours. As I had occasion to judge from a comparison with other years for the same stations, the "Mean Temperature" is throughout too warm; also the circumstance that the means of maximum and minimum, when combined, give the temperature *cooler* than the values adopted there, confirms it in an independent form; they are not even comparable amongst themselves, the hours used not being everywhere the same. I never failed to mention, when I found the data indicated there showing no material deviations, but I did not introduce them into my tables unless I had no other materials; in such cases I recalculated the results, deducing them from the maximum and minimum instead of taking what there is the mean[1] temperature; the resulting values for *seasons* and *years* had to be calculated separately everywhere, as they are contained for none of the values in the parliamentary meteorological registers.—The verbal description of climate is very careful throughout.

OFFICIAL MATERIALS PRINTED IN INDIA.

Amongst the *official materials printed in India* I have to name, for meteorological data, those selections from the Records of Government which contain information in reference to the localities proposed to be used as mountain or marine sanitaria. On account of this practical point of view I did not exclude from my tables even such isolated hill stations as Dérhi, Rhotásgărh, &c., for which the data included but a very limited period of time; in the paper I had presented to the Royal Society I had not entered into such details.

The principal publications are those of 1861 and 1862.

A. Report on the Sanitary Establishments for European Troops in the Bengal, Madras, and Bombay Presidencies. Selections from the Records of the Government of India. 1861, No. II.; 1862, No. III.

[1] The extremes being in most cases not the results of registering instruments, but SR and an afternoon hour, (most frequently just 4 P.M. being used). I was the more authorized to do so.

B. Duncan Macpherson, Reports on Mountain and Marine Sanitaria within the Presidency of Madras, the Straits of Malacca, the Andaman Islands, and British Birmah. From January 1858 to January 1862, Madras. Selections from the Records of Government, No. 74, *A.* 1862.

Also Dr. Balfour's work "Barometrical Sections of India,"[1] Madras, 1853, contains, p. 31, some determinations of mean temperature based upon observations of minimum and maximum, viz. probably Sunrise and an early hour of the afternoon. As I have no further details as to the deduction of the "means" and as to which other hours might have been combined, I give the monthly means only for Árkot, Belgău, and Nágpur, for which I have no other data.

For the *Himálaya* no works on meteorology or physical geography have been published in particular; amongst the recent travels those of Cunningham, Hooker, and Strachey contain detailed and very careful meteorological observations; only it would be desirable that these, as well as their predecessors, might have been able more frequently to leave behind native observers for continued registers.

For climate and physical geography also Royle's splendid work, "Illustrations of the Botany and other branches of the Natural History of the Himálaya Mountains," London, 1839, contains many and various data.[2]

SCIENTIFIC JOURNALS AND THE LOCAL PUBLICATIONS OF INDIA.

A great variety of meteorological notices were to be found in Indian publications; the communication of observations with instruments are not very numerous, but descriptive notes on climate and atmospheric phenomena are frequently very valuable, particularly if personal experience allows one to judge of the details, which otherwise might appear too short. Also for the resident such notices are often welcome analoga for comparison with his own place; this may justify my having occasionally given isolated facts as well as mean general considerations. They are arranged topographically.

[1] For the hypsometrical materials of this work see "Results," Vol. II., p. 7.

[2] The ten Reports made by us to Government during our travels, "On the Progress of the Magnetic Survey," contained the various data on climate and physical Geography, to which we had occasion to add some details before Parliament in 1858, printed in the Papers "On Colonization and Settlement in India," 4th Report, p. 1—10.

Many of the scientific periodicals having no registers sufficiently detailed, my looking them through for such materials took up much time; but finally I could not but be perfectly satisfied with the variety of data I had found. Shorter notices about climate which I could no more enumerate in the following list, may be met with in other local publications, such as Medical topographies, Statistics, Records from the revenue departments; I left them out for abbreviation, and chiefly because most of the information they contain may be considered as included already in the communications I quoted. Also in THOMSON's "Gazetteer" most of the articles on "provinces" contain some notes on climate.

The history and the great variety of *Ancient Indian Literature* might allow one to expect that some data could be met there in connection with the question whether or not *changes* in the climate could be traced. Nothing precise in form, naturally, could be expected; even in Europe everywhere science had made many a profound discovery before the pagan form of prediction of wind and weather had been limited by the study of the physical causes upon which they depend. What I looked for, at least, was to find some data for exceptional meteorological phenomena; but in vain, and Jyótisha, the sacred Vedaic calendar, arose simply from the necessity of teaching how to fix the proper time for sacrificial acts, and what it contains of lunar and solar astronomy is of very little value, even fully allowing for its antiquity.

For study and information, particularly for those of my Indian readers who may be inclined to add to the stock of our materials by taking an active part in observations and researches, I quote for physical geography in general Mrs. SOMMERVILLE's and Sir JOHN HERSCHEL's recent works; for meteorology exclusively we have in German the well-known larger works of KÄMPTZ[1] und SCHMID, and various Handbooks of recent date.

In the arrangement of the list of Literature the provinces and stations are given in alphabetical succession; in the quotations the year, as the most important of the details, is put first; in many instances, such as Year-books, even in some of the regular periodical publications, pages could not be quoted because several parts of the same volume begin

[1] KÄMTZ, "Handbuch," 4 vols. 1836; E. E. SCHMID, "Lehrbuch," 1860; MÜHRY, "Allgemeine geogr. Meteorologie," 1860; CORNELIUS, "Meteorologie," 1863, &c. In French, MARTINS, "Cours complet de Météorologie de KÄMPTZ," 1858. An appendix on graphical representation by LALANNE is added.—Compare also FR. GALTON's "Meteorographica," London, MACMILLAN and Co., 1864.

with page 1; but in such cases, the articles being long, it is easy to find them in the volume characterized by the year. Many of the earlier articles without careful numeric observations which I had to quote, can be considered as materially superseded by those of more recent date.

In order to avoid repetition I have united here all the details in reference to meteorology, not limiting myself to the special objects of this volume only.

I. TEMPERATURE AND CLIMATE.

A. *India.*

Affghanistán. Irwin, Memoir on the Climate, &c., of Affghanistán. 1839 and 1840, Journ. As. Soc. Beng.

—— Griffith, Tables of Meteorological Observations made in Affghanistan, Upper Sindh, Kutch, Gundama, 1839-41. 1842, Journ. As. Soc. Beng.

—— Remarks on the Climate of Affghanistan. 1841, Journ. As. Soc. Beng., part II.

Ágra and North-west Provinces. Revenue Meteorological Statements of the N.W. Provinces for the years 1844, 45, 49-50. 1853, Agra.

—— Abstract of the Daily Temperature at the various Stations in the Cis and Trans Sutlej States in 1851. Yearbook, N.W. Provinces.

—— Meteorological Register kept at the office of the Government of the N.W. Provinces, Agra. 1852-56 Journ. As. Soc. Beng.

Ambála. Abstract of Thermometer kept at Umbala 1835-38. 1838, Journ. As. Soc. Beng.

Andamán Islands, with notes on Barren Island. Records of the Government of India. Calcutta 1859, No. XXV.: General Physical Character, &c., pp. 4-28.

Arakán Coast. Remarks on the Climate of Cheduba. 1844, Journ. Soc. Beng., part I.

Assám. J. W. Masters, Meteorological Observations in Upper Assám, made during the years 1839-42. Calc. Journ. Nat. Hist., Vol. IV.

Audh. Donald Butter, Outlines of the Topography and Statistics of the Southern Districts of Oudh. Calcutta 1839.

Áva. Burney, Register of Thermometer, 1830, 1831. Gleanings in Science.

Bánda. Meteorology of the District of Banda. 1850, Journ. As. Soc. Beng.

Bandelkhánd. Franklin, On Bandelkhand, in the Trans. of the R. As. Soc., Vol. I.

Bangalór. Register of the Average Temperature for 1838. 1841, India Jour. med. and phys. Soc.

—— Meteorology of Bangalore, April 1839-40. 1842, India Journ. med. and phys. Soc.

—— Atmospheric Phenomena at Bangalore 1844-45. 1846, Calcutta Journ. Nat. Hist.

Barēli. On the Climate of Bareilly. Gleanings in Science.

Belgáū. R. H. Hunter, Temperature and Climate of Belgáū, 1838, 1839. Ind. Journ. med. and phys. Soc., Vol. VI.

Bellári. Register of the Average Temperature at Bellary. Glean. in Sc. 1839; Ind. Journ. med. and phys. Soc., Vol. VI.

Benáres. Prinsep, Abstract of a Meteorological Journal kept at Benares in 1824, 1825, and 1826. 1829, Glean. in Sc.

Bhuj. Dr. James Burnes, General Remarks on the Medical Topography of Bhuj, prepared in 1828, printed in the selections from the Records of the Bombay Government, Nr. 15, 1855.

Bombây. J. Nicholls, Remarks upon the Temperature of the Island of Bombay during the years 1803 and 1804. London, 1819. Trans. Lit. Soc. Bomb., Vol. I.

—— Mean Annual Temperature. 1838, Ind. Journ. med. and phys. Sc. Calc.

—— Annual Registers of the Kolába Observatory. The observers' names shall be given with the resulting means.

—— G. Buist, Meteorological Observations during the Eclipse of the Sun, Dec. 21, 1843. Journ. Bomb. Branch of the R. As. Soc.

—— G. Buist, Meteorological Observations. 1844, Journ. Bomb. Branch of the R. As. Soc.

Calcutta. M. W. Wollaston. 1836, Physical Geography of Calcutta.

—— Annual Meteorological Registers of the Surveyor-General's Office. As general abstracts I still add: J. M'Clelland, in Calc. Journ. of Nat. Hist. 1841 and 1845; and H. L. Thuillier, Meteorological Summary for 1847. Journ. As. Soc. Beng.

Central India. SIR JOHN MALCOLM, Report on the Province of Malwa and adjoining Districts. 1822, Calcutta.

Ceylon. Abstract of a Meteorological Register kept at Batticotta. 1849, Journ. As. Soc. Beng.

—— ALLAN SIEVERIGHT, Extract from the Meteorological Observations at the Royal Engineer Observatory, Colombo, for 1853. Ceylon Alm. and Ann. Register.

—— A. SHAW, Observations made at the Office of the Civil Engineer and Commissioner of Roads, Peradenia. 1853, Ceylon Alm. and Ann. Register.

Dånvah. Temperature at Dunwah. Journ. As. Soc. Beng. 1848, part II.

Dáinapur. Meteorological Observations of Dinapoore Circle during the year 1838, by F. MARSHALL. 1841, Ind. Journ. med. and phys. Soc.

Dékhan and Maisúr. COL. H. W. SYKES. Various Important Memoirs in the Philosophical Transactions: 1835, 1850, and 1855. They are quoted in detail with the respective stations.

Fattihpúr Síkri. On the Climate of Fattihpoor Sickri (Table of the monthly mean temperature). 1830, Glean. in Sc.

Indian Archipelago. CAPTAIN ELLIOT's Magnetic Survey of the Indian Archipelago, combined with numerous Meteorological Observations. 1851. Philos. Trans. and Meteorological Observations at Singapore, 1841-45. 1850, Madras.

Indus. PERCEVAL LORD, Temperature of the Plain of the Indus. 1838, Ind. Journ. of med. and phys. Sc.

Kachár. R. STEWART, Abstract of Meteorological Observations taken in Northern Cachar. 1855, Journ. As. Soc. Beng.

Kålsi. BAIRD SMITH, Reduction of Meteorological Observations, made at Kulsea. 1837-41. Calc. Journ. of Nat. Hist., Vol. IV.

Karrák. H. D. ROBERTSON, Meteorological Observations, made at Karrack and Bushire. 1842, Journ. Bombay Branch of the R. As. Soc.

Kólhapur. Abstract Return, showing the Range of the Thermometer and Fall of Rain from 1847 to 1851, at Kolhapoor; Selections of the Rec. of the Bomb. Gov.

Krishnagånj. McDOWALL, Statement of the Weather for 22 years, 1800-22, made at Krishnagunj, near Rungpoor. 1838, Trans. of the Agric. and Hortic. Soc. of India.

Kvétah. Temperature of Kwettah. 1841, Ind. Journ. of med. and phys. Science.

Lăknáu. Meteorological Observations kept at the Residency, Lucknow, 1854. 1854 and 1855, Journ. As. Soc. Beng.

Madrás. Annual Registers of the Madras observatory. For details see station Madrás.

—— Register of Monthly Mean Temperature for the Districts of New Orleans, Houston, Florida, Georgia, Carolina, and Madras. 1850, Journ. Agr. and Hort. Soc. of India.

—— E. Balfour, Barometric Sections. Abstract exhibiting the Temperature at the stations Madras, Arcot, Trinchinopoly, Bangalore, Bellary, Belgaum, Secunderabad, Megpore. Madras 1853.

Maghassáni Hills, as a Sanitarium. Select. Rec. of Gov. Beng. 1861, XXXVI., part II.

Mahalbaléshvar. J. Murray, Tabular View of the Meteorology of the Convalescent Station of the Mahabaleshvar Hills, 1838. 1828-38, India Journ. of med. and phys. Soc.

Maharátta districts. A. T. Christie, Sketches of the Meteorology, Geology, Agriculture, &c. of the Southern Mahratta Country. 1828, Jameson, New phil. Journ.

Míräth. T. Jackson, General and Medical Topography of Meerut. 1828, Transactions of the med. and phys. Soc. Calc., I.

—— John Murry, On the Topography of Mirath. 1839, Calcutta.

—— Ch. Gubbins (now Bothoe), Daily Register of Temperature at Meerut 1850. 1852, Journ. As. Soc. Beng.

Mulmén. Temperature at Moulmein for 1836. Ind. Journ. of med. and phys. Sc.

Närbåda. G. G. Spilsbury, Climate of the Valley of the Nerbuda, 1820, 1823, 1825, 1828, 1829. Glean. in Sc.

Nílgiris. Table exhibiting the Temperature in the Neelgeeries, Seerlo, Jackanany, and Utakamand, by Macpherson. 1825, Trans. of the med. and phys. Soc. of Calcutta.

—— Joseph Glen, Meteorological Observations at Utacamand in the Nilgirri Hills. 1829-36, Ind. Journ. of med. and phys. Soc.

—— T. G. Taylor, Meteorological Observations made at Dodabetta 1847-50.

Nílgiris. Sykes, Discussion of Meteorological Observations at Dodabetta on the Neelgeri Mountains. London 1850.

Oudh, *see* Audh.

Parisnáth. G. v. Liebig, Discussion of some Meteorological Observation, made on Parisnáth Hill in 1856. Journ. As. Soc. Beng.

Rámpur. Heat very great at Rámpur in Summer. 1839, Journ. As. Soc. Beng., part II.

Rámpur Bóleah. R. J. Bedford, On the Meteorology of Rampoor Bauleah. 1851, Journ. As. Soc. Beng.

Ranigánj. D. H. Williams, Observations on the Temperature of the External Atmosphere and in the Raneegunge Mine. 1846, Calcutta Rec.

Rangún. J. Fayrer, Meteorological Observations kept at the Rangoon Field Hospital, 1852, 1853. 1852 and 1853, Journ. As. Soc. Beng.

Saráuli. Brew, Reduction of Meteorological Observations, made at Surrowli on the Duab Canal, 1837-41. Calc. Journ. of Nat. Hist., Vol. IV.

Sindh. The climate of the part of Lower Sindh out of the influence of the sea breeze, very bad, &c. 1840, Journ. As. Soc. of Beng., part II.

—— Dr. Kirk, Medical Topography of Upper Sindh. Calcutta 1847.

—— Tables of Height in Sindh, the Pănjáb, N.W. Provinces, and Central India, to May 1862. G. T. S. Calcutta, 1863. It contained the height for several of the meteorological stations from data which had not yet been known to us when the Vol. II. of the "Results" was published.

Tátta. Meteorological Observations, made at Camp near Tatta during the months of March, April, and May 1839. Selections Rec. Bombay Gov.

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Turán Mall. F. A. V. Thurburn, Meteorological Observations, made at Turan Mall, 1851. Journ. As. Soc. of Beng.

Trevándrum. J. Caldecott, Observations on the Temperature of the Ground at Trevandrum 1842-45. 1847, Edinburgh.

B. *Himálaya, Tíbet.*[1]

Bhután. R. B. Pemberton, Barometrical and Thermometrical Observations, made in various parts of Bootan, 1838.

Kănáur. Difference of Temperature at Various Heights in Kănáur and Spiti. 1840, Journ. As. Soc. Beng., part I.

— Climate of Kănáur. 1844, Journ. As. Soc. Beng., part I.

— Patrick Gerard, A General Statement of the weather at Kotgurh and Soobathoo 1819-21. 1829, Glean. in Sc.

Kashmír. Remarks on the Climate of Kashmír. 1837, Journ. As. Soc. Beng., part II. Compare observations during the travels in Vigne's and Hügel's works.

Ladák. Cunningham, Ladák and the surrounding countries; 1854, Climate pp. 171-190.

Nepál. A. Campbell, Meteorological register kept at the Kathmandu Residency in 1837. Journ. As. Soc. Beng.

— Climate of Nayakote. 1840, Journ. As. Soc. Beng., part II.

— G. H. Robinson, Meteorological Register kept at Kathmandu. 1843, Journ. As. Soc. Beng.

— Meteorological Observations made in Nepál and Síkkim. 1854, Journ. Agr. and Hort. Soc. of India.

— B. H. Hodgson, Papers relative to the Colonization, Commerce, Physical Geography, &c., &c., of the Himalaya Mountains and Nepal. Selections from the Records of the Gov. of Bengál, 1857, No. XXVII.

Síkkim. Joseph Glen, Meteorological Observations at Calcutta and Dargeeling, 1834-38, 1840, 1841. Ind. Journ. of med. and phys. Soc.

— Meteorological Register kept at Darjeeling, 1836, 1837. 1848, Ind. Journ. of med. and phys. Soc.

— J. D. Hooker, Himalayan Journals; Vol. II.; Appendices. London 1854.

— W. S. Shervill, Notes upon some Atmospherical Phenomena, observed at Darjiling, 1852. 1854, Journ. As. Soc. Beng.

[1] General works, as those by Hamilton, Hodgson, Hooker, Jaquemont, Moorcroft, Strachey, &c., also contain, besides the topographical details, numerous though isolated data for the meteorology, snow line, &c. of the various provinces.

II. RADIATION, MIRAGE, EVAPORATION,[1] SNOW LINE.

Radiation. WEATHERHEAD, Meteorological Observations, chiefly on Solar Radiation, made at Mhow. 1841, Ind. Journ. of med. and phys. Sc.; Vol. VI.

—— J. CAMPBELL, On Solar Radiation. 1842, Calc. Journ. of Nat. Hist.

—— at Dånvah; on the Káimor Hills; Mírzapur. 1848, Journ. As. Soc. Beng., part II.

Mirage. JOSEPH GURY, On Optical Illusions, Mirage, and Meteors. 1840, Calc. Journ. of Nat. Hist.; Vol. III.

—— JAMES ABBOTT, On the Mirage of India. 1854, Journ. As. Soc. Beng.

Evaporation. Experiments on Evaporation, made in the vicinity of Calcutta. 1829, Glean. in Sc.

—— Experiments on Evaporation performed at Vera Cruz, 1818-20. 1829, Glean. in Sc.

—— Daily Rate of Evaporation in Calcutta 1845. 1848, Journ. As. Soc. Beng.

—— F. W. LADLEY, Observations on the Rate of Evaporation on the open Sea. 1845, Journ. As. Soc. Beng.

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III. THERMOMETERS AND GRAPHICAL REPRESENTATIONS.

STANDARDS; ENGLISH AND GERMAN FORMS. Correction of the freezing point, alteration by time, by heat, by height. Gen. SABINE's freezing point of the Mercury. My Thermometers without bulb for the Correction of the Stem.

CONSIDERATIONS FOR METEOROLOGICAL STATIONS. Selection of the Place; Thermometer in peripheric motion. Registering Instruments. Scales employed. Range of the Thermometers. Table of Reduction.

GRAPHICAL REPRESENTATIONS. STAMPFER's Planimeter for taking means; my Revolving Scale for comparing variability (and linear measurement in general).

STANDARDS; ENGLISH AND GERMAN FORMS.

Our instruments[1] we had occasion to compare in full detail before our departure with those of the Kew observatory; of the thermometers our two standards were made by NEWMAN; I left them at the observatories of Calcutta and Madras before returning to Europe.

In the NEWMAN thermometers, the division was engraved upon the glass stem itself; they reached from below the freezing point to above the boiling point of water; and also the variations within the scale were measured by calibration.[2] They were the basis for the determination of the corrections of the other instruments. The form of the glass stem being used for the application of the division of the scale has the advantage of perfectly excluding any alteration in mutual position of tube

[1] The instruments used for the meteorological and physical observations are figured on a separate plate, to which description notes are added; here I limit myself to some remarks in direct connection with the Thermometers.

[2] The calculation of the corrections from the readings of the calibration has been developed with particular accuracy by BESSEL, Pogg. Ann., Vol. 6, p. 287; the more recent methods described by EGEN, Pogg. 11, 529; 13, 46; and by RUDBERG, Pogg. 40, 562, must be quoted on account of the facility of their application.—My Newmans had the centigrade scale, with the boiling point, as generally for most of the standards, coinciding with 760 Millimeters of pressure. In many Fahrenheit thermometers the pressure adopted is 30 Eng. inches = 762 Mill.; in the Réaumur thermometers the pressure frequently is 28 par. lines = 758 Millim.—In using thermometers for measuring heights such differences become quite appreciable.

and scale, and is very well adapted for standards which always are used with every possible care; but for general purposes they are not solid enough, and, which is more important perhaps, in all cases in which the bulb and the stem cannot be absolutely of the same temperature (as in determining the temperature of the surface of the ground, of springs, &c.), a sensible error can be produced by the bulb being of a different temperature from that of the stem, whilst in the thermometers we generally used the second cylinder surrounding the stem is a decided protection.

The thermometers of the Indian Medical Establishment I found to be, with few exceptions, by the best makers in England, such as ADIE, ELLIOT, NEWMAN, TROUGHTON, SIMONS, &c.; and, as thermometers have so much less to risk by being sent about than other instruments, viz. barometers, &c., they were generally in perfect order.

Our own thermometers I had made at Berlin (whilst ADOLPHE was then occupied with other preparations in London), partly by GEISSLER, partly by GREINER. They differed from those of English construction in as much as the scale was not placed upon the glass stem, or, as is more general, upon metallic plates, but upon semi-transparent glass, enclosed together with the capillary tube in a cylinder of glass. The bulb naturally remained uncovered by this cylinder, which was attached immediately above it; in Germany for ordinary purposes also a paper scale is enclosed instead of the scale of transparent glass. This form considerably reduces the secondary influence of the temperature of the scale. They were all kindly compared at the Kew Observatory by Mr. WELSH, before our departure, and the freezing and boiling points were also frequently controlled during our travels.

In consequence of the contraction of the bulb of the thermometer not yet reaching its maximum with the cooling of the glass, it generally happens that the scale of the thermometers, notwithstanding its partial and local irregularities, is a little too high throughout; this correction can best be determined at the freezing point; I had occasion in many instances to fix it also for the stations by direct comparison with our standard thermometers from Kew. It generally exceeded $^1/_2$° Fahr., not unfrequently it reached 1° Fahr. The means given in the following tables of this volume *are already corrected;* in the means formerly published in the Journal As. Soc. I found such corrections constantly neglected wherever I had occasion to trace them to the original manuscripts.

The error of the scale does not become constant; it can be affected again by pressure and temperature. As to the first, I have mentioned its influence already in the Physical Geography of the Alps,[1] and I found the results there obtained quite corroborated by the comparison of thermometers in the Himálaya and Tíbet.[2] A reduction of pressure causes an expansion of the bulb and, in consequence, a lowering of the values of the scale; it can be easily verified by exposing a thermometer immersed in a fluid of constant temperature, such as melting ice,[3] to a variation of pressure under the bell of an air-pump; also two pieces of ice gently pressed against the bulb of a delicate thermometer between the fingers show, I found, the effect in the opposite form. But these alterations of the correction, very important for physical experiments or for the determination of the boiling point, are indifferent for ordinary meteorological observations.

Another modification, with an effect in the same sense as that of the reduction of pressure with height, is produced by the constant influence of tropical heat; as I found in the mean of my various thermometers, it decidedly causes an increase of the size of the bulb, or diminishes to a certain extent the error produced by the contraction once undergone already after the instrument has left the maker's hands. In several instances I found this alteration making $^1/_3$ of a degree Fahrenheit,[4] an amount appreciable enough to be taken into consideration by standard observatories. Also for such delicate questions as the determination of the extreme minimum of moisture in the atmosphere, as I found it in Tíbet (reaching to one per cent. of relative moisture, whilst the minimum known before was that of HUMBOLDT's 16 per cent. in Central Asia[5]), every precaution is absolutely necessary.

Till recently the expansion of the mercury in the lower degrees, approaching its freezing point, had not yet been determined with sufficient accurary with the

[1] "Physical Geography of the Alps," Vol. II., p. 275.

[2] "Results," Vol. II., p. 27.

[3] Also the temperature of congelation itself varies with pressure, as THOMSON has shown, 1850; Phil. Mag., p. 123. In consequence of *this* the zeros determined in great heights must be raised, but very little indeed, practically not in any appreciable degree; for THOMSON only found it to amount to $^1/_{10}{}^0$ Fahr. with an increase of pressure to eight atmospheres.

[4] It was very favourable for the definitive settlement of various questions of this kind, that some of the instruments much used were brought home in good order.

[5] HUMBOLDT, "Asie centrale," German edit., II., p. 51. Details are given already "Results," Vol. II., p. 38.

thermometer filled with air, which is considered as the one of standard contraction;[1] in the Kew observatory General SABINE now uses fluid carbonic acid, prepared when ordered in large quantities by Mr. ADAMS in London, for continuing the determination of the loss of expansion of mercury down to its freezing point, and Mr. STEWART has reduced thus about $^1/_4$ of a cubic foot of mercury to a cheesy metal of a temperature of nearly 70° Fahr. below that of the freezing point of water, he obtained at the same time the value for the contraction of the mercury in its lower parts a little more rapid than had been admitted, chiefly from REGNAULT's experiments. As far as I know, the details are not yet published; I owe the data here communicated to Mr. STEWART personally.[2]

When the scale of a thermometer is determined, bulb, capillary tube above the bulb, and scale, are of the same temperature. So it actually is the case again in the determination of the temperature of the air, or when the instrument is immersed down to the point where read, into the ground or water, if the instrument does not exceed a certain length. But for those instruments of 4, even of $8^1/_2$ feet in length as I had them made for the determination of the temperature of the ground and obtaining finally the subterraneous isothermal lines within the strata of earth next to our atmosphere and not a little affecting the temperature of the latter, it was evident that the bulb was immersed in a stratum not of the same temperature as that of the layers of 1 and 2 meters superposed through which the stem had to pass. Insolation of the ground, its moisture, its power of conducting heat, are elements so variable, that a theoretical consideration at once must prove insufficient for general application; I had therefore introduced a method of direct experimental determination.

[1] About the comparison of the thermometers filled with air and alcohol, see POUILLET, Compt. rend. 1837, T. 1., and Pogg., Ann. 41, p. 151; experiments of the mercury and air, when used in thermometers, are published by REGNAULT in Pogg., Ann. 41, 151, and MAGNUS, Pogg., Ann. 57, 194.

[2] HANSTEIN, during his journey to Eastern Sibiria from Tomsk to Irkuzk, in 1829, had repeatedly occasion to compare the mercury thermometer with the alcohol thermometer down to the freezing point of the mercury. The temperature of the latter he found (by the alcohol thermometer) 69·8° Fahr. below that of the water).

The difference of the two thermometers he found to be represented by the formula

$$A - M = + 0°{\cdot}45 - 0°{\cdot}1006\,\mathfrak{z} + 0°{\cdot}008523\,\mathfrak{z}^2$$

where, in degrees Réaumur, A is the reading of the alcohol, M that of mercury, $\mathfrak{z}$ the numbers of degrees below — 10° R. But, as recently observed in the Annuaire of the French Meteorological Society, it is to be desired that his determinations be repeated by another series of experiments. BAUDIN, Annuaire de la Société météorologique, p. 33, 1862. MOIGNO, Les Mondes, October 15, 1863. From HANSTEIN's observations it would appear that from — 23° R. already the contraction of the mercury begins to be greater than that of alcohol and that the difference rapidly increases the more the congelation of mercury is approached.

For this purpose two thermometers as nearly equal as possible were constructed; the capillary tube was enclosed in a strong brass cylinder and protected against too immediate contact with its walls by an envelopment of cotton and sawdust supported by cylinders of cork. The two instruments being compared (the resulting correction being about the same for both), in one of them the capillary tube was melted together just above the bulb by the rapid action of a powerful blowpipe and the bulb dropped off. I now had one thermometer with bulb and stem, and one thermometer with stem only, and it was easy to compare them, by immersion into a fluid of known temperature, so as to see what were the alterations in the readings of the complete instrument by the stem being immersed in a stratum of temperature not equal to that in which the bulb rested. These delicate instruments were made by J. Greiner at Berlin.

The results will be communicated in connection with the temperature of the ground; suffice it here to say, that in consequence of the very careful isolation of the tube from the surrounding metallic cylindrical case, the disturbance by the local affection of the temperature of the capillary tube was remarkably small, a result considerably facilitating the work of reduction and comparison.—Of the thermometers reaching from the beginning of the scale to the bulb 1 meter (3·28 ft.) below the ground we had a sufficient number to carry them about with us during our travels; of those reaching down to 2 meters (6·56 ft.), I had three sets made, which we left for continued observation during an annual period and more at principal stations such as Calcutta, Madras, Bombay, Agra, &c. The one I tried to bring home with me was broken during my passage through Egypt.

CONSIDERATIONS FOR METEOROLOGICAL STATIONS.

The selection of the place for the determination of the temperature of the air and of the moisture, also the mode of putting up the instruments, is frequently not done with sufficient care; it may be worth a few explanatory words; the error, even if not very great apparently, becomes important, if we consider that its absolute value remains the same for the mean, and that the latter altogether does not differ for very many full degrees, unless height or latitude is changed very much.

It is evident that the influence of radiated or reflected heat is equally to be avoided with the influence of direct insolation. To find a place sufficiently protected is

in most cases easy enough, but again very easily such a position can be so modified that the instrument cannot freely follow the diurnal changes; in the interior of a house even the mean only accidentally coincides with that of the free atmosphere.

For a comparison of the temperature at two localities, even if one thermometer only should be at hand, the method of accelerating the sensibility of the instrument by rapidly swinging it about in the atmosphere, by a *peripheric* motion, as for instance a sling, can be used with advantage. In our latitudes, where the action of the sun is not so powerful, such a rapid motion of a delicate thermometer through the atmosphere even nearly excludes the effect of insolation; in the tropics it is sufficient, when properly made, at all events completely to exclude for the moment minor disturbances; the thermometer so rapidly takes the temperature of the air that no time is left for a sensible action of glare and radiation. The one reading being made at a well-situated place in peripheric motion, then the instrument being hung up in its position to be examined, and finally a concluding experiment in peripheric motion being made, the mean of the 1st and the 3rd reading can be considered as the test of the correct position during the 2nd.[1]

The distance between the points of sunrise and sunset not including so great a part of the horizon, and their position not varying so much in the tropics as in higher latitudes, materially facilitates the selection of the place; but the power of the sun's rays and the consequent intensity of glare and radiation increases the difficulty; even this being overcome, I often met instruments put up in a position which, if not affecting sensibly the means of the day, could not but interfere with their representing the full variation during the twenty-four hours.[2] I particularly allude to such instances where the instrument is put up close to a wall, or at too short a distance from it; we then may obtain the temperature of the wall, which on an average does not differ *much* from that of the atmosphere, but differs sufficiently to alter the character of the variability of the climate, and what is not indifferent either—the error at every station is not even the same. In the standard observatories, such as the principal towns, also in many others, in Darjíling, Ambála, Rúrki, &c., I found the instruments put up under a pretty high roof of reeds in the centre of an open shed

[1] Examples of local variation see under "Kashmir."

[2] For details as to local influences I quote the very interesting experiments recently made by Mr. BECQUEREL with an electrical thermometer, and described in the French Academy. Journal Cosmos, 1863, p. 679.

of 25 to 20 feet in diameter, only resting on distant columns. This indeed is very much to be recommended, but naturally it cannot be done everywhere; and indeed, the well-shaded side of a house protected against rain being selected, it is sufficient there to put up the instrument so as to be distant enough from the wall; for instance, by suspending it between two horizontal holders of wood or iron at about one foot from the wall. For our own use I had made gimblets with a metallic holder[1] attached to the handle. The instrument passed through two such gimblets was perfectly secure as to its steadiness, and was most easily put up at every new halting place.

Registering instruments, minimum and maximum, are very valuable for completing the meteorological observations; but in general they are not so correct as ordinary plain mercury thermometers, and they require, more particularly, to be handled with much greater care, being considerably more liable to get out of order.

In the minimum filled with alcohol it often happens that by distillation a part of the alcohol gets transferred to the other end of the tube;[2] recently also instances have been observed in which, probably through microscopic fissures produced by considerable variations of temperature rapidly succeeding each other, even all the alcohol had disappeared, without any fissure being visible.[3] In the maximum aluminium floaters were substituted for those of steel; and altogether the variety of instruments, including WALVERDIN's deversion thermometers, GAZELLI's minimum, PHILIPPS's speck of air, &c., is greater than might be expected. For travellers, also for observers far distant from the occasional assistance of a mechanician, none of them, I think, from our experience, can be sufficiently safe or constant in its indications. For the temperature of the air I

[1] Figured in the Plate of *Instruments;* the holder could be turned backward and then also protected the point of the gimblet when packed.

[2] In the tropics alcohol thermometers are also subjected to disturbances from the pressure of steam developed inside, alcohol boiling at 140° Fahr., mercury only at 612° Fahr.—Very good registering instruments are those used at Kew and described in Part I., and II. of the Kew observations: they have been sent out recently also to Melbourne, as General SABINE informed me.—In the Journal "Les Mondes," 1864, p. 158, a new registering thermometer by GOVI is described (from the proceedings of the Turin Academy). It is filled with gas, and has every advantage of accuracy, but its large volume must limit its general use.

[3] As a very remarkable instance I quote the observation of Dr. KOLB of Paris, a very active and scientific member of the Alpine club, on the top of Monte Rosa. The minimum thermometer put up July 16th., 1860, he found July 4th., 1862, perfectly empty, the index lying in the very centre of the bulb. See TUCKETT, "Peaks, Passes, and Glaciers," Vol. II., second series. Also HOOKER's observations about the receding of the zero point ("Himalayan Journals," Vol. II., Append. A., p. 358) are quoted by TUCKETT as analogous cases.

preferred watching the hours of extremes, and reading the instruments at the respective periods; in cases in which direct reading was not possible, such as in the determination of the temperature at the bottom of lakes, in great depth of the ground, &c., I preferred employing a quite different system; I made thermometers so slow by sufficient protection against rapid alteration of temperature, that I could read them directly after being brought out.[1]

We used for ourselves chiefly the centigrade scale, but in these publications the readings are converted throughout into Fahrenheit, and I can but add from the continued use of both scales, that, as far as there is a distinction to be made in such things, where uniformity is of much greater importance than selection, I have reason to prefer the Fahrenheit scale. Its advantages are a smaller unit and, observations in high latitudes or great elevations excepted, the greater simplicity in calculation by avoiding negative numbers; it is but to be regretted that 32 for the freezing point is still not sufficiently high to completely exclude negative numbers; whether the difference between freezing and boiling heat of water is 80, 100, or 180 is perfectly indifferent in reference to mathematical formulæ.[2]

The range of thermometers for practical use I found most desirable, where instruments of that length had no other objections, was one comprising the freezing point and the boiling point of water. This has the advantage of allowing the principal control of the scale without an additional standard for comparison. For the temperature of the air of the tropics 10° Fahr. to 150 are sufficient, the latter being approached occasionally by the most superficial strata of dark soil exposed to the full power of insolation. In order that a thermometer may be exposed to the sun's rays or to

[1] For details of these apparatus see Vol. V., and the Plate of Instruments. Also those used for experimental researches about radiation and insolation are detailed there. Those I used at Ambála were described in my 3rd. official Report, reprinted in the Journal As. Soc. Beng., 1856.

[2] I do not intend by these details to allude to a *general* introduction of this or any of the other scales; it is sad to see how much time and mental power is absolutely wasted in reductions so plain, that they have not even the value of mental exercise. But at present the time has not yet come, and as yet national as well as personal ambition has but too often interfered with the adoption of a neighbour's idea. If in the French revolution the toise or half the toise could have been made the meter with its decimal system of division, we do not know but that all the continent—where still for scientific objects such as height, the old French foot is in use—would have adopted it. Perhaps the Fahrenheit scale, say with 132 for 32 and 312 for 212, for the avoidance of negative numbers, might be expected to become most general, being now already the one used, not only in England, but also in the western hemisphere as well as in most parts of the tropics and to the south of them. For a general comparison of more than 20 scales once in use since Galilei's invention of the thermometer, about the year 1610 according to Libri, see E. E. Schmitt, "Lehrbuch der Meteorologie," p. 74.

the determination of hot springs[1] without risk of its bursting in case the temperature rises higher than expected, it is advisable that its capillary tube should have an enlargement at its upper end. For this purpose it is very easy to have the determination of the boiling point defined also for thermometers not including the full length. If the capillary tube at the place where it is to end for the general use of the instrument, is enlarged, and if above this enlargement it is continued, about ¼ of an inch, it is easy to modify this form so as to make the upper part include the degrees between 205 and 220° Fahr. It is important for instruments which are much carried about, that the space of the capillary tube should be absolutely free of air. That this is the case is easily seen by the mercury running down to the very end and retiring without breaking when the thermometer is turned gently.

In order to facilitate the study of the results of the various continental works on meteorology, it will be allowed to add a table of comparison of the various scales now in use. Plain as it is, it may not be unwelcome to those to whom such reductions are not so familiar in consequence of the occasion less frequently presenting itself.[2] For limiting the size of the table the central parts most generally met with are those most detailed.

[1] We had hot springs in the Himálaya which were even warmer (in consequence of the salt they contained) than the boiling point of distilled water corresponding to the simultaneous pressure of the air.

[2] Though in these researches the communication chiefly had to be limited to the new materials and results collected, occasional auxiliary explanations and tables will be excused by their facilitating for Indian residents the contributing of new data, and by assisting particularly the numerous native observers employed.

Comparison of Thermometric Scales.

$$\left.\begin{array}{r}\frac{5}{9}(\text{F.} - 32)\\ \frac{5}{4}\text{R.}\end{array}\right\} = \text{C.} \qquad \left.\begin{array}{r}\frac{9}{5}\text{C.} + 32\\ \frac{9}{4}\text{R.} + 32\end{array}\right\} = \text{F.} \qquad \left.\begin{array}{r}\frac{4}{9}(\text{F.} - 32)\\ \frac{4}{5}\text{C.}\end{array}\right\} = \text{R.}$$

Cent.	Fahr.	Réaum.	Cent.	Fahr.	Réaum.	Cent.	Fahr.	Réaum.
— 25	— 13·0	— 20·0	— 7·0	+ 19·40	— 5·60	— 2·0	+ 28·40	— 1·60
— 24	— 11·2	— 19·2	— 6·8	19·76	— 5·44	— 1·9	28·58	— 1·52
— 23	— 9·4	— 18·4	— 6·6	20·12	— 5·28	— 1·8	28·76	— 1·44
— 22	— 7·6	— 17·6	— 6·4	20·48	— 5·12	— 1·7	28·94	— 1·36
— 21	— 5·8	— 16·8	— 6·2	20·84	— 4·96	— 1·6	29·12	— 1·28
— 20·0	— 4·0	— 16·0	— 6·0	21·20	— 4·80	— 1·5	29·30	— 1·20
— 19·5	— 3·1	— 15·6	— 5·8	21·56	— 4·64	— 1·4	29·48	— 1·12
— 19·0	— 2·2	— 15·2	— 5·6	21·92	— 4·48	— 1·3	29·66	— 1·04
— 18·5	— 1·3	— 14·8	— 5·4	22·28	— 4·32	— 1·2	29·84	— 0·96
— 18·0	— 0·4	— 14·4	— 5·2	22·64	— 4·16	— 1·1	30·02	— 0·88
— 17·5	+ 0·5	— 14·0	— 5·0	23·00	— 4·00	— 1·0	30·20	— 0·80
— 17·0	1·4	— 13·6	— 4·9	23·18	— 3·92	— 0·9	30·38	— 0·72
— 16·5	2·3	— 13·2	— 4·8	23·36	— 3·84	— 0·8	30·56	— 0·64
— 16·0	3·2	— 12·8	— 4·7	23·54	— 3·76	— 0·7	30·74	— 0·56
— 15·5	4·1	— 12·4	— 4·6	23·72	— 3·68	— 0·6	30·92	— 0·48
— 15·0	5·0	— 12·0	— 4·5	23·90	— 3·60	— 0·5	31·10	— 0·40
— 14·5	5·9	— 11·6	— 4·4	24·08	— 3·52	— 0·4	31·28	— 0·32
— 14·0	6·8	— 11·2	— 4·3	24·26	— 3·44	— 0·3	31·46	— 0·24
— 13·5	7·7	— 10·8	— 4·2	24·44	— 3·36	— 0·2	31·64	— 0·16
— 13·0	8·6	— 10·4	— 4·1	24·62	— 3·28	— 0·1	31·82	— 0·08
— 12·5	9·5	— 10·0	— 4·0	24·80	— 3·20	0	32·00	0
— 12·0	10·4	— 9·6	— 3·9	24·98	— 3·12	+ 0·1	32·18	+ 0·08
— 11·5	11·3	— 9·2	— 3·8	25·16	— 3·04	0·2	32·36	0·16
— 11·0	12·2	— 8·8	— 3·7	25·34	— 2·96	0·3	33·54	0·24
— 10·5	13·1	— 8·4	— 3·6	25·52	— 2·88	0·4	32·72	0·32
— 10·0	14·00	— 8·0	— 3·5	25·70	— 2·80	0·5	32·90	0·40
— 9·8	14·36	— 7·84	— 3·4	25·88	— 2·72	0·6	33·08	0·48
— 9·6	14·72	— 7·68	— 3·3	26·06	— 7·64	0·7	33·26	0·56
— 9·4	15·08	— 7·52	— 3·2	26·24	— 2·56	0·8	33·44	0·64
— 9·2	15·44	— 7·36	— 3·1	26·42	— 2·48	0·9	33·62	0·72
— 9·0	15·80	— 7·20	— 3·0	26·60	— 2·40	1·0	33·80	0·80
— 8·8	16·16	— 7·04	— 2·9	26·78	— 2·32	1·1	33·98	0·88
— 8·6	16·52	— 6·88	— 2·8	26·96	— 2·24	1·2	34·16	0·96
— 8·4	16·88	— 6·72	— 2·7	27·14	— 2·16	1·3	34·34	1·04
— 8·2	17·24	— 6·56	— 2·6	27·32	— 2·08	1·4	34·52	1·12
— 8·0	17·60	— 6·40	— 2·5	27·50	— 2·00	1·5	34·70	1·20
— 7·8	17·96	— 6·24	— 2·4	27·68	— 1·92	1·6	34·88	1·28
— 7·6	18·32	— 6·08	— 2·3	27·86	— 1·84	1·7	35·06	1·36
— 7·4	18·68	— 5·92	— 2·2	28·04	— 1·76	1·8	35·24	1·44
— 7·2	19·04	— 5·76	— 2·1	28·22	— 1·68	1·9	35·42	1·52

Comparison of Thermometric Scales.

$$\left.\begin{array}{r}\frac{5}{9}(F. - 32)\\ \frac{5}{4}R.\end{array}\right\} = C. \qquad \left.\begin{array}{r}\frac{9}{5}C. + 32\\ \frac{9}{4}R. + 32\end{array}\right\} = F. \qquad \left.\begin{array}{r}\frac{4}{9}(F. - 32)\\ \frac{4}{5}C.\end{array}\right\} = R.$$

Cent.	Fahr.	Réaum.	Cent.	Fahr.	Réaum.	Cent.	Fahr.	Réaum.
+ 2·0	+ 35·60	+ 1·60	+ 6·0	+ 42·80	+ 4·80	+ 10·0	+ 50·00	+ 8·00
2·1	35·78	1·68	6·1	42·98	4·88	10·1	50·18	8·08
2·2	35·96	1·76	6·2	43·16	4·96	10·2	50·36	8·16
2·3	36·14	1·84	6·3	43·34	5·04	10·3	50·54	8·24
2·4	36·32	1·92	6·4	43·52	5·12	10·4	50·72	8·32
2·5	36·50	2·00	6·5	43·70	5·20	10·5	50·90	8·40
2·6	36·68	2·08	6·6	43·88	5·28	10·6	51·08	8·48
2·7	36·86	2·16	6·7	44·06	5·36	10·7	51·26	8·56
2·8	37·04	2·24	6·8	44·24	5·44	10·8	51·44	8·64
2·9	37·22	2·32	6·9	44·42	5·52	10·9	51·62	8·72
3·0	37·40	2·40	7·0	44·60	5·60	11·0	51·80	8·80
3·1	37·58	2·48	7·1	44·78	5·68	11·1	51·98	8·88
3·2	37·76	2·56	7·2	44·96	5·76	11·2	52·16	8·96
3·3	37·94	2·64	7·3	45·14	5·84	11·3	52·34	9·04
3·4	38·12	2·72	7·4	45·32	5·92	11·4	52·52	9·12
3·5	38·30	2·80	7·5	45·50	6·00	11·5	52·70	9·20
3·6	38·48	2·88	7·6	45·68	6·08	11·6	52·88	9·28
3·7	38·66	2·96	7·7	45·86	6·16	11·7	53·06	9·36
3·8	38·84	3·04	7·8	46·04	6·24	11·8	53·24	9·44
3·9	39·02	3·12	7·9	46·22	6·32	11·9	53·42	9·52
4·0	39·20	3·20	8·0	46·40	6·40	12·0	53·60	9·60
4·1	39·38	3·28	8·1	46·58	6·48	12·1	53·78	9·68
4·2	39·56	3·36	8·2	46·76	6·56	12·2	53·96	9·76
4·3	39·74	3·44	8·3	46·94	6·64	12·3	54·14	9·84
4·4	39·92	3·52	8·4	47·12	6·72	12·4	54·32	9·92
4·5	40·10	3·60	8·5	47·30	6·80	12·5	54·50	10·00
4·6	40·28	3·68	8·6	47·48	6·88	12·6	54·68	10·08
4·7	40·46	3·76	8·7	47·66	6·96	12·7	54·86	10·16
4·8	40·64	3·84	8·8	47·84	7·04	12·8	55·04	10·24
4·9	40·82	3·92	8·9	48·02	7·12	12·9	55·22	10·32
5·0	41·00	4·00	9·0	48·20	7·20	13·0	55·40	10·40
5·1	41·18	4·08	9·1	48·38	7·28	13·1	55·58	10·48
5·2	41·36	4·16	9·2	48·56	7·36	13·2	55·76	10·56
5·3	41·54	4·24	9·3	48·74	7·44	13·3	55·94	10·64
5·4	41·72	4·32	9·4	48·92	7·52	13·4	56·12	10·72
5·5	41·90	4·40	9·5	49·10	7·60	13·5	56·30	10·80
5·6	42·08	4·48	9·6	49·28	7·68	13·6	56·48	10·88
5·7	42·26	4·56	9·7	49·46	7·76	13·7	56·66	10·96
5·8	42·44	4·64	9·8	49·64	7·84	13·8	56·84	11·04
5·9	42·62	4·72	9·9	49·82	7·92	13·9	57·02	11·12

Comparison of Thermometric Scales.

$$\left.\begin{matrix}\frac{5}{9}(\mathrm{F.} - 32) \\ \frac{5}{4}\mathrm{R.}\end{matrix}\right\} = \mathrm{C.} \qquad \left.\begin{matrix}\frac{9}{5}\mathrm{C.} + 32 \\ \frac{9}{4}\mathrm{R.} + 32\end{matrix}\right\} = \mathrm{F.} \qquad \left.\begin{matrix}\frac{4}{9}(\mathrm{F.} - 32) \\ \frac{4}{5}\mathrm{C.}\end{matrix}\right\} = \mathrm{R.}$$

Cent.	Fahr.	Réaum	Cent.	Fahr.	Réaum.	Cent.	Fahr.	Réaum.
+ 14·0	+ 57·20	+ 11·20	+ 18·0	+ 64·40	+ 14·40	+ 22·0	+ 71·60	+ 17·60
14·1	57·38	11·28	18·1	64·58	14·48	22·1	71·78	17·68
14·2	57·56	11·36	18·2	64·76	14·56	22·2	71·96	17·76
14·3	57·74	11·44	18·3	64·94	14·64	22·3	72·14	17·84
14·4	57·92	11·52	18·4	65·12	14·72	22·4	71·32	17·92
14·5	58·10	11·60	18·5	65·30	14·80	22·5	72·50	18·00
14·6	58·28	11·68	18·6	65·48	14·88	22·6	72·68	18·08
14·7	58·46	11·76	18·7	65·66	14·96	22·7	72·86	18·16
14·8	58·64	11·84	18·8	65·84	15·04	22·8	73·04	18·24
14·9	58·82	11·92	18·9	66·02	15·12	22·9	73·22	18·32
15·0	59·00	12·00	19·0	66·20	15·20	23·0	73·40	18·40
15·1	59·18	12·08	19·1	66·38	15·28	23·1	73·58	18·48
15·2	59·36	12·16	19·2	66·56	15·36	23·2	73·76	18·56
15·3	59·54	12·24	19·3	66·74	15·44	23·3	73·94	18·64
15·4	59·72	12·32	19·4	66·92	15·52	23·4	74·12	18·72
15·5	59·90	12·40	19·5	67·10	15·60	23·5	74·30	18·80
15·6	60·08	12·48	19·6	67·28	15·68	23·6	74·48	18·88
15·7	60·26	12·56	19·7	67·46	15·76	23·7	74·66	18·96
15·8	60·44	12·64	19·8	67·64	15·84	23·8	74·84	19·04
15·9	60·62	12·72	19·9	67·82	15·92	23·9	75·02	19·12
16·0	60·80	12·80	20·0	68·00	16·00	24·0	75·20	19·20
16·1	60·98	12·88	20·1	68·18	16·08	24·1	75·38	19·28
16·2	61·16	12·96	20·2	68·36	16·16	24·2	75·56	19·36
16·3	61·34	13·04	20·3	68·54	16·24	24·3	75·74	19·44
16·4	61·52	13·12	20·4	68·72	16·32	24·4	75·92	19·52
16·5	61·70	13·20	20·5	68·90	16·40	24·5	76·10	19·60
16·6	61·88	13·28	20·6	69·08	16·48	24·6	76·28	19·68
16·7	62·06	13·36	20·7	69·26	16·56	24·7	76·46	19·76
16·8	62·24	13·44	20·8	69·44	16·64	24·8	76·64	19·84
16·9	62·42	13·52	20·9	69·62	16·72	24·9	76·82	19·92
17·0	62·60	13·60	21·0	69·80	16·80	25·0	77·00	20·00
17·1	62·78	13·68	21·1	69·98	16·88	25·2	77·36	20·16
17·2	62·96	13·76	21·2	70·16	16·96	25·4	77·72	20·32
17·3	63·14	13·84	21·3	70·34	17·04	25·6	78·08	20·48
17·4	63·32	13·92	21·4	70·52	17·12	25·8	78·44	20·64
17·5	63·50	14·00	21·5	70·70	17·20	26·0	78·80	20·80
17·6	63·68	14·08	21·6	70·88	17·28	26·2	79·16	20·96
17·7	63·86	14·16	21·7	71·06	17·36	26·4	79·52	21·12
17·8	64·04	14·24	21·8	71·24	17·44	26·6	79·88	21·28
17·9	64·22	14·32	21·9	71·42	17·52	26·8	80·24	21·44

Comparison of Thermometric Scales.

$$\left.\begin{array}{l}\frac{5}{9}(F.-32)\\ \frac{5}{4}R.\end{array}\right\} = C. \qquad \left.\begin{array}{l}\frac{9}{5}C.+32\\ \frac{9}{4}R.+32\end{array}\right\} = F. \qquad \left.\begin{array}{l}\frac{4}{9}(F.-32)\\ \frac{4}{5}C.\end{array}\right\} = R.$$

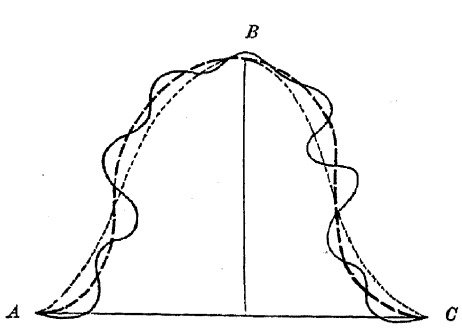
Cent.	Fahr.	Réaum.	Cent.	Fahr.	Réaum.	Cent.	Fahr.	Réaum.
+ 27·0	+ 80·60	+ 21·60	+ 33·0	+ 91·40	+ 26·40	+ 50	+ 122·0	+ 40·0
27·2	80·96	21·76	33·2	91·76	26·56	51	123·8	40·8
27·4	81·32	21·92	33·4	92·12	26·72	52	125·6	41·6
27·6	81·68	22·08	33·6	92·48	26·88	53	127·4	42·4
27·8	82·04	22·24	33·8	92·84	27·04	54	129·2	43·2
28·0	82·40	22·40	34·0	93·20	27·20	55	131·0	44·0
28·2	82·76	22·56	34·2	93·56	27·36	56	132·8	44·8
28·4	83·12	22·72	34·4	93·92	27·52	57	134·6	45·6
28·6	83·48	22·88	34·6	94·28	27·68	58	136·4	46·4
28·8	83·84	23·04	34·8	94·64	27·84	59	138·2	47·2
29·0	84·20	23·20	35·0	95·0	28·0	60	140·0	48·0
29·2	84·56	23·36	35·5	95·9	28·4	61	141·8	48·8
29·4	84·92	23·52	36·0	96·8	28·8	62	143·6	49·6
29·6	85·28	23·68	36·5	97·7	29·2	63	145·4	50·4
29·8	85·64	23·84	37·0	98·6	29·6	64	147·2	51·2
30·0	86·00	24·00	37·5	99·5	30·0	65	149·0	52·0
30·2	86·36	24·16	38·0	100·4	30·4	66	150·8	52·8
30·4	86·72	24·32	38·5	101·3	30·8	67	152·6	53·6
30·6	87·08	24·48	39·0	102·2	31·2	68	154·4	54·4
30·8	87·44	24·64	39·5	103·1	31·6	69	156·2	55·2
31·0	87·80	24·80	40·0	104·0	32·0	70	158·0	56·0
31·2	88·16	24·96	41	105·8	32·8	71	159·8	56·8
31·4	88·52	25·12	42	107·6	33·6	72	161·6	57·6
31·6	88·88	25·28	43	109·4	34·4	73	163·4	58·4
31·8	89·24	25·44	44	111·2	35·2	74	165·2	59·2
32·0	89·60	25·60	45	113·0	36·0	75	167·0	60·0
32·2	89·96	25·76	46	114·8	36·8	76	168·8	60·8
32·4	90·32	25·92	47	116·6	37·6	77	170·6	61·6
32·6	90·68	26·08	48	118·4	38·4	78	172·4	62·4
32·8	91·04	26·24	49	120·2	39·2	79	174·2	63·2

GRAPHICAL REPRESENTATIONS.

Meteorological data can be represented not only by numbers but also by mathematical diagrams, viz. by curves determined by two systems of co-ordinates, one of which is based upon a unit of time, the other upon a unit of difference of temperature, pressure, &c. As this mode of representation is independent of the scale employed, it materially facilitates comparison; for temperature I used it for the types of climate which are added to the isothermal lines, Plate IV. of the Illustrations of Meteorology.

The surface covered by such figures is at the same time in direct proportion to the mean temperature; the latter can be deduced by mathematical formulæ; for rapid comparison I frequently used a planimeter by Weltli and Starke at Vienna, described by Stampfer.[1] By following the contour of the space included by the curve or parts of the curve and the respective co-ordinates the surface of this space (expressed by my instrument in square centimeters) is obtained, and the resulting mean is easily deduced.

In comparing meteorological curves also their rectilinear length can be taken into consideration as proportional to the variability. If a quotient is formed from the first part of the curve, *A* to *B*, divided by the rectilinear distance (in diagonal direction) between the minimum *A* placed as the beginning to the maximum *B;* and if the same is done for the second part of the curve by the diagonal distance from the maximum to the re-appearance of the minimum, *B* to *C*—we obtain absolute values independent of the relative proportions of the two systems of co-ordinates.



Supposing three curves to be compared of the forms as these here drawn, though the "mean" may be the same for the three, it is easily seen that their length varies considerably; the one drawn as a dotted line is the shortest, next to it comes the broken line, the full line is the longest. The variability of the phenomena represented is proportional to the length of the curves, evidently differing considerably from the mere distance between maximum and minimum, or from the surfaces

[1] Stampfer, "Ueber Planimeter," Wien, Braunmiller.—Also for various other curves, such as hydrographical sections, &c., this instrument can be employed.

included by the curves and the horizontal axis of co-ordinates. Even if the units adopted for the co-ordinates should be no more the same for the curves to be compared, we can compare the absolute values of their variability obtained by the formula

$$\frac{(AB)}{AB} + \frac{(BC)}{BC}$$

(AB), (BC) being the length of the curve between A and B, and B and C, AB, BC being the rectilinear distance between the extremes of the curve.

This consideration also allows one to compare any two mathematical curves, independent of the elements they represent; such as thermical with hygrometrical or barometrical curves, &c., in reference to their variability. The comparative concluding considerations on the meteorological phenomena in general will offer many an occasion for such analysis.

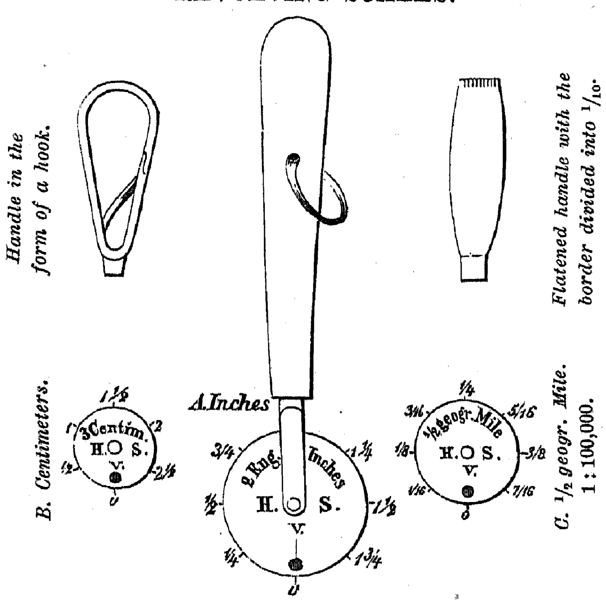
Revolving Scale for measuring curves. For practically measuring a curve a pair of compasses can be but insufficiently employed; even if we do not mind the trouble of opening the compasses but very little, we obtain, according to the form of the curve, only a result comparable to that obtained by measuring the periphery of a circle in the form a polygon. This led me to the construction of a little instrument which, by its revolving motion over a curve, defines its length by the number of revolutions or parts of one, *without the additional use of a measuring scale.*

This little wheel, — I called it *Revolving Scale* (*Molette métrique* in French, *Scalenrädchen* in German) — proved itself to be also applicable to the measuring of curved lines on maps or plans, such as rivers, roads, or for the construction of plans and sections, where co-ordinates had to be drawn; as in English maps the absolute measure of the inch and its proportion to a certain number of miles is the basis of the scale, the revolving scale can be combined with the absolute scale of the inch (in French maps and plans the centimeter with the kilometers).

My instrument, represented in the woodcut annexed, was exhibited first at the French Academy (Comptes Rendus, Aug. 17, 1863) by General Morin; at the British Association, Newcastle, in September of the same year, by Mr. Lockyer; in German I described it in the Astr. Nachrichten for December 1863, and in Dingler's Polyt. Journ. for October. I may be allowed to mention that the numerous reprints and abstracts which have appeared in various scientific and military papers, have induced me to give here the

description of an instrument which, from its simplicity and applicability to such various purposes, proves so serviceable, that I might have expected it to have existed in this form a long time already.

REVOLVING SCALES.



The Opisometer of Mr. Elliot, also, was invented for measuring the length of a curved line by a wheel; this however was no measure in itself, but by its turning round the position upon a screw was altered in a horizontal direction, and it finally had to be pulled on along a scale in an opposite direction till the wheel again reached the point of the screw where it started from. As a great difficulty, it must be mentioned that the starting position at the beginning is only defined "by a vertical position in the hand." In the *Revolving Scale* the points, by the little dots they leave, not only mark the beginning, but they enable one to see all along the line, whether it has been followed accurately, and if so they leave the line marked off at the same time.

Its principal part is a metallic wheel, the circumference of which is divided by prominent steel points. The axle of the wheel rests in the two lobes of the handle.[1] By rolling it over a line, straight or curved, the points leaving delicate marks, we obtain:

1. The number of inches, centimeters, &c. (into which the circumference is divided) for the total length.

2. The line itself has become marked off, and intermediate parts of it can be compared with each other without the necessity of measuring again.

3. If pulled on along a ruler, a linear measuring tape of paper is obtained at once.

As the dimensions I found to be the most convenient for physical and topographical purposes I may mention the following:

A. For inches:

Size of the circumference 1 or 2 inches, the numbers 0 $^1/_4$ $^1/_2$ $^3/_4$ 1 $^1/_4$ $^1/_2$ $^3/_4$ being engraved in the wheel above the respective points; the beginning, 0, and, if of the larger size also the half of the circumference, 1 being distinguished by double points juxtaposed.

[1] The handle can easily be modified so as to allow one to carry the little instrument on the watch-chain.

B. For centimeters.

The circumference may best be made equal to 3 centimeters, these being subdivided once, and the full centimeters being distinguished by double points.

C. For topographical measurement on maps which are to be measured in geographical (or other) miles, the proportion of the scale being 1 : 100,000 or parts of it, half a geographical mile has been taken as the unit, the circumference so becoming 1·37 French inches and the diameter 5·23 French lines for 1 : 100,000; the German geographical mile being adopted (with Bessel) = 3807·23 toises. For a map in the proportion of 1 : 144,000 or multiple of it, a circumference of 2 inches subdived into duodecimal parts may be said to be the best; when of this size the complete circumference corresponds to 24,000 feet, or 1 duodecimal mile, and the revolving scale at the same time is the absolute measure of inches, marked off every two lines; the beginning and end obtain double points.

On every wheel the beginning of the division is marked by a broader line connected with the zero, this being a full dark ellipse. Besides, opposite to the zero point a little prominence is fixed into the wheel, which touches with every complete revolution a small spring which *sounds.* This materially accelerates its use in measuring as, till near the end of the line to be measured, not the single marks but only the complete revolutions are to be counted.

In reference to the mechanical details I limit myself to adding, that the edge of the wheel must be narrow and edentated all round, in order to offer sufficient friction when moved over the paper; the points are sharp and *short*, so as to completely enter into the paper. As in the use of a pair of compasses, here too the paper must be placed upon a basis sufficiently soft to facilitate the precision in the contact of the circumference of the wheel with the line and the impression of the points. If maps are to be examined it with be found useful, in many instances, to examine also the scale engraved, in order to see whether any appreciable contraction of the paper after the printing has taken place, as not unfrequently it will be found to be the case.

The precise application will be found easy enough. The little resistance at every impression of a mark allows one to see as well as to feel them, and the impression of a division all over the line is not only useful for roads, rivers, &c. on maps, but also when examining curves of any kind it shows at once many details for comparison of their various parts, also facilitating the first deduction of mathematical formulæ.

IV. THE DAILY PERIOD OF TEMPERATURE.

PRINCIPAL DEPENDENCY UPON THE POSITION OF THE SUN. General sources of terrestrial heat: Proper heat of the globe; Temperature of Space; heat derived from the Sun.

INSOLATION AND RADIATION. Instruments for experimental Observations, readings of Thermometers in the Sun's Rays. The Sun's heating power greater along the sea-shore than in the interior. Influence of moisture upon accumulation of heat in the different provinces. TYNDALL's Experiments on Heat.

HEAT TRANSMITTED FROM THE MOON. MELLONI's direct proof of heating power. Analysis of very long meteorological Series.

NUMERICAL DATA AND DESCRIPTIVE REMARKS TO ILLUSTRATE THE DAILY VARIATION. Hourly observations at Bombay; Madrás; Calcutta; Ambála. Types varying with season and locality. Hot Winds. Sea-breezes. Second Depression after the principal minimum.

(*Daily variation* is deduced from *hourly* observations or means; *annual variation* from *monthly means*.)

PRINCIPAL DEPENDENCY UPON THE POSITION OF THE SUN.

The periodical variation of temperature—its daily and yearly range—may best be introduced by some considerations about the modifying causes.

The rays of the sun would produce an increase of temperature in direct conformity to the changes of his position above the horizon, did not time exercise so great an influence upon the effects of insolation and radiation. Now we see that the maximum is not reached with the greatest height of the sun, but only 2 to 3 hours later, in the tropics as well as in higher latitudes; and even the disappearance of the sun below the horizon does not cause a sudden change in the form of the daily curve, but the cooling by radiation continues with nearly uniform progress till the moment of the re-appearance of the sun the following morning. Littoral climates, the rainy season with its clouded sky, when the direct action of the sun and the loss of heat is most limited, show the smallest variation; but they also approach most a daily change proportional to the curve of the sun, and particularly a great uniformity during the night. Continental regions with an unclouded sky, and great heights, where the variety

of the atmosphere partially accelerates the changes, show the most rapid variation, and here the loss of heat continues during all the night.

In the central tropical regions, in fact, the maximum is much oftener than not even later than in higher latitudes; also an unclouded sky cannot cause the time of maximum to approach much the culmination of the sun; it remains 2 to 3 hours distant in consequence of the continued active power of the sun's rays. In great heights, such as in the dry Tibetan climate, the radiation not unfrequently begins to overpower insolation soon after the sun's culmination and so causes the maximum to come nearer the centre of the day. The same we also observe in elevated Alpine regions of our European latitudes; but here the obliquity of the sun's course produces still another modification which even in the greatest heights, where we had occasion to pass a night, could not be traced in Tíbet. In the Alps I had observed that the increase of the temperature often precedes for several hours the rise of the sun.[1] I think it is sufficient to explain it from the circumstance that the sun rises and sinks so much more vertically and rapidly in Tibetan than in European latitudes.

It would be a consideration too general and theoretical to enter here into the *analysis* of the *sources* of terrestrial heat; the three principal causes so ably developed by Fourier[2] are the following: The proper heat of our globe;—the temperature of the space of the universe in which our globe moves;—the heat derived from the sun. The first and the second of these elements, however, have but a very small share in the thermic modifications we observe on the surface of the earth; in the general outlines they do not even become apparent.

The proper heat of our globe we find increasing rapidly—as far as it can be traced in mines, artesian wells, &c.—when descending into great depths.[3] It is considered the rest of a general higher temperature; if it were the action of the sun,

[1] For the highest points where nights were passed, up to 19,326 feet, see "Results," Vol. II., p. 481; "Phys. Geogr. of the Alps," Vol. II, p. 292.

[2] Fourier, Memoires de l'Ac. des sciences de Paris, T. VII, 1827.

[3] For very interesting details see the results obtained from the mines in Cornwall and Devonshire by Fox, British Assoc., 10th. Rep., p. 309. As the resulting mean, based upon all the details, Bishof (Die Wärmelehre des Inneren unseres Erdkörpers, p. 382), and Studer ("Phys. Geogr. und Geol.," Vol. II., p. 37) obtain 50 feet for the increase of 1° Fahr., their individual results differing but for about 1 foot. Our Indian researches offered no materials to add to the definition of these values; our observations not reaching beyond the depth which is still affected by the atmospheric temperature; as far as I know no data exist from the tropics of the ancient world, and those of the tropics of America are limited to mines which themselves are situated at a very great elevation.

the temperature below the strata within which the periodic variations can be observed, could but show either a uniform temperature down to the centre of the earth in case the action of the sun has lasted long enough to have raised its heating effect to a terminal value, or a decrease towards the centre in case such terminal value had not yet been reached.

The temperature of the space of the universe in which our globe moves is another element modifying the thermic conditions of the earth; notwithstanding the ingenious theoretical and experimental researches connected with these questions by men like FOURIER, HERSCHEL, HOPKINS, POUILLET, the numerical definition is still very vague; some obtained values ranging between 90 and 108° Fahr. below freezing point (FOURIER); whilst POUILLET's result for the temperature of the space was — 214° Fahr. included between the limits of — 283 and — 175° Fahr.[1] All we can positively say is that the earth is situated in a space with the incandescent sun in its central region and a temperature much below the freezing point of water in the opposite direction. That this space is not absolutely cold, or, as we only could imagine this, that not the sun alone is our source of heat, is corroborated by the circumstances that if so, the variations of temperature would be much greater and more directly connected with the distance of our globe from the sun, also the difference between day and night would be more intensive and more sudden.

The Sun and the modification of the heating power of insolation remain therefore nearly exclusively the sources to which all variation of temperature and, in consequence, most of the periodic changes in the meteorological phenomena are to be traced. Together with the physical conditions of the sun and the elements of the orbit of the earth,[2] it is particularly the distribution of land and sea which most essentially modifies the thermal conditions on its surface (when referred to one level). It was HUMBOLDT who first fully detailed, in 1817, the difference between continental and littoral climate; and amongst the recent contributions to these leading questions the various discoveries connected with DOVE's researches are to be quoted.

The secondary action of the sun by the eventual influence of the moon upon the earth is, as we shall see, remarkably small in reference to the chances of a thermic effect.

[1] POUILLET had expected to find that the atmosphere might have a region colder than the space, viz. a temperature increasing from a certain height towards the earth as well as towards the space; his calculations did not confirm this; but HOPKINS ("Leonh. and Bronn," 1857, p. 188) recently obtained are analogous result.

[2] See for astronomical detail: MEECH, "On the relative insensity of Heat and Light of the Sun." Washington, Smithsonian Institution, 1856.

INSOLATION AND RADIATION.

The tropics, where the intensity of solar action is greatest, are the regions where we may expect the influence of the modifying causes to become apparent most distinctly, and one of the results which during our travels presented itself amongst the very first deserved my particular attention, since I think it had not yet been sufficiently taken notice of in the analysis of meteorological observations—I mean the influence of relative moisture in *increasing* the effect of insolation by reducing the simultaneous radiation, as long as transparency is not yet limited by the interference of haze or fog.

The instruments put up for the determination of the temperature of the air in the shade, as described before, are placed so as to be as independent as they possibly can be from local disturbances; they have to show the temperature of the storm, the breeze, the resting or gently undulating stratum of the air, unmodified by the objects touched next; particularly solar heat reflected or radiated from the surrounding objects was mentioned as to be excluded, since no other disturbance can become so arbitrary and uncertain.

But again the question can be asked, what is actually the direct power of the sun's rays; and it might appear as easy to observe it as the temperature of the air in the shade, by now exposing a thermometer to the full action of the sun's rays, had not here again the surrounding objects the power of individual modification.

For experimental observations apparatus like that of SAUSSURE,[1] HERSCHEL[2], POUILLET,[3] or the exposure of a thermometer with blacked bulb on a surface of black wool,[4] must be used for obtaining values absolutely comparable; but for many a general question the free exposure of a thermometer to the sun's rays at a sufficient distance from a heated back-ground is a most precious material, particularly here, where irregularities in the course of meteorological phenomena are less frequent. Readings of a thermometer in the sun have been made in India at many stations, and at some for many years; if till now they were not duly examined and compared, the reason was that a great number indeed were made so that the thermometer being put up close to a stone wall, or at a small elevation above a ground partly moist,

[1] Heliothermometer in "Voyages dans les Alpes, 1787—1796," § 932.

[2] Actinometer, in Report of the 3rd meeting of the British Assoc. Cambridge, 1833.

[3] Pyrheliometer in Pogg., Ann., 90, p. 544.

[4] It would be too long to enter here already into details which will be given together with the experiments we had occasion to make. A description of the apparatus we used I gave in my Third Report upon the Progress of the Magnetic Survey, 1856, Journal As. Soc. of Bengal.

partly dry, occasionally black soil, now dense fanning grass—made them incomparable, arbitrary. Also the nature of the instrument, for instance the glass being unusually strong or greenish, may essentially modify such readings.

The instrument, when imperfect, has chiefly the quality of making such readings too low by being not delicate[1] enough; slow instruments will not become sufficiently warm at the time of the maximum; it is true, they will not become either sufficiently cool during the opposite period; but this, though limiting their error for readings such as the daily means, is no amelioration here, where the maximum is what we most want to know. The personal examination of the different stations has shown readings too low to be more frequent than those where they were overheated by too great vicinity to dry black ground; whilst for the temperature in the shade the case is the opposite one.

The visit, however, of the various provinces now described also allowed me to find for every one of them data fairly comparable, and those are added, together with the tables of absolute extremes in the shade,[2] to the groups I formed; the experimental series of observations we made during our own stay in the various regions are to follow, together with the determinations of transparency and intensity of light from which they may not well be separated; but the general results of the observations of plain insolation I preferred putting together already here to illustrate some of the principal causes of the modification of temperature. The curves by which the results are represented are figured on Plate 4 of the Meteorological Atlas; the numerical values of the fundamental tables can be considered as the mean of the reading in the early afternoon of every day, supposing the sky to have been so unclouded as to allow a distinct shadow to be thrown. If between Noon and 4^{h} P.M. no moment sufficiently clear presented itself, no observations were

[1] This is quite analogous for instance to the circumstance that the temperature of the insolated ground does not become either as hot or as cool at some depth as it will become on the very surface.

[2] Also in the tables of the Parliamentary publication I have met to my great pleasure the readings of several of the thermometers I had put up. As here the mean did not require any particular care in the combination, if only days where no insolation was observed remained excluded, such values could be entered into my tables with preference which were observed after my visit of the respective places, though I had not received as yet the detail of the readings. I may be allowed to add, however, as then easily such mistakes can be avoided in official reports, that in the papers I had received from the Medical Board the means sent in—happily together with the original reading, day by day—had been formed so that days where no insolation could be observed had been entered too in the divisor, viz., they were introduced as if 0° Fahr., or alias some 100 degrees below the temperature of the air in shade had been read on such days.

noted this day, and the mean was deduced for the month only from the number of days when observations could be made. Evidently this must be called arbitrary in some degree, if we have to ask for the final effect produced by the sun in the various provinces; but the irregularities are much less numerous than at first might be expected; the number of days, even in the rainy season, on which no readings could be made is smaller than might be thought, and, which is more important, here, for the theoretical questions connected with these observations, it was necessary to make them as independent as possible from an accidental number of days clouded in the afternoon. And I must add that we should be going too far if we considered such observations made in any form ever to become of such generally comparable nature as those of the temperature of the air in the shade; for the thermometer in the sun may be put up under circumstances as uniform as possible, the only question how much of the ground *of a province* is black soil, or jungle, or rock, is sufficient to show that the heat produced by the sun's rays may attain a degree proportional everywhere for one of the modifications of the soil to the readings of the insolated thermometer, but not so in the sum-total it attains. The topographical form of a province, whether flat or hilly, has an influence much greater still.

The readings of the insolated thermometers show as the principal result that *all along the sea-shore the heating power of the sun is greater than in the interior; and again, the absolute maxima of insolation coincide with days when the relative moisture is great;* days in the rainy season, when the clouds are interrupted for some time, or the months following the rainy season, when still moist—these are the periods showing the absolute extremes on the thermometer in the sun's rays.[1]

It is therefore not only our personal sensation, if in such regions we feel the slightest touch of the solar rays more oppressive, more dangerous;[2] this increase of solar action upon man has been combined with the suppression of evaporation and perspiration in

[1] One of the highest maxima ever observed in Calcutta I got communicated from General Thuiller's Observatory at the Surveyor-General's office; it was 147° Fahr., Oct. 29, 1863. The relative humidity was at the same time 69, though the day was clear and bright. In May 142° Fahr. is observed not unfrequently. In Jhánsi, in Central India, though several degrees farther to the south and much warmer in the shade, 140° Fahr. is the maximum I only once found noted near the end of the hot season.

The insolation, more than the temperature in the shade, also allows one to recognise the influence of the earth's smaller distance from the sun during the hibernal part of her course.

[2] In German we use the expression *stechend* to designate that "stinging" heat of the sun's rays experienced on a clear but moist day in summer, or during a break in the summer rain.

a moist climate, which certainly has a share in it for animal organism, but the thermometer, when exposed to the sun, shows it too.[1]

If we follow the annual variations, as well as compare stations like those of Bengál and the Pănjáb, the connexion of this maximum of insolation with the periods or regions of great moisture becomes equally evident. In the Pănjáb, where during a considerable part of the year—which, however, is the dryest—the mean of the air as well as the maxima in the shade so far exceed those all over the rest of India, that now the system of isothermal lines includes a region of absolute extreme at a time which is not even the *hot season* for the tropical[2] parts of India, we find not one month for which the power of insolation would be but approximatively proportional.[3] For the mean insolation of *the year* we see a zone of maximum, including the islands and coasts to the east and west of India from Bombay and Calcutta down to the central parts of the Indian ocean, so essentially differing from the narrow elliptical maximum zone of annual mean in the shade connecting India with Ceylon.

For the hot and rainy season the Indian islands and the southern shores of the peninsula differ too much in reference to the temperature in the shade from the regions a little farther to the north, to allow of the insolation reaching the same absolute height: also a kind of mist is for a considerable part of these months so dense that days may be apparently clear enough to enable one to observe insolation, but its full power is materially reduced by the hazy condition of the atmosphere.

In the cool season, when the height of the sun above the horizon has consider-

[1] Also in Europa, heat, which is not unfrequently "felt" with such different intensity, may be traced, I found, recently again from a comparison of English and French observations of last summer, 1863, to a very different height of the insolated thermometer in England, even if for simplicity such days were selected when the air in the shade had the mean temperature.

[2] When I made this remark at Calcutta before my departure, it was observed to me that this very circumstance of insolation being stronger in Hindostán had made the medical authorities doubt altogether of the correctness of the meteorological registers sent in from the Pănjáb, and so neither the high temperature in the shade nor the comparatively lower insolation had become known.

[3] The higher latitude of the Pănjáb naturally reduces the height attained by the sun; for Noon it is found by the formula

$$H = 90 - \varphi + \delta$$

where φ is the polar altitude, δ the declination. For the other hours we obtain it from the formula

$$\sin H = \sin \varphi \sin \delta + \cos \varphi \cos \delta \cos t.$$

But when we consider that insolation is not in so direct a connexion with the height alone of the sun above the horizon, but not less with the increase of the atmospheric temperature during the first hours following the culmination it is easily seen that the difference of latitude within the regions here compared has but a share of comparatively speaking minor importance.

ably decreased for the northern regions, and when in addition, the rapid diminishing of the temperature in the shade from south to north materially modifies the temperature resulting for the insolated thermometer, a decided depression also begins to be felt when proceeding to the northern shores of the Indian seas, whilst near the equator, the altitude of the sun being but little altered, the reduction of its distance becomes felt, increasing its effect.

What latitude in the cool season produces for the tropics, is, in the mountains, for a great part, the effect of height, but again not exclusively. This was decidedly shown by the experiments I had occasion to make in Síkkim and in Ladák, where in both instances, the elevation, the altitude of the sun, even occasionally the temperature of the atmosphere in the shade, was the same; but when in Síkkim only a break in the clouds of an hour or two had to be watched to obtain readings of insolation far exceeding the effect of the sun when glaring down from the unclouded sky of Tíbet.

The principal reason why a thermometer, when exposed to insolation on a high mountain, does not reach the same absolute degree of heat as when exposed lower down, is to be sought in the *simultaneous loss of heat by radiation.* As seen by the temporary position in shade of the pyrheliometer[1] I used, it was the greater in proportion to the difference of temperature, to the rarefaction of the surrounding medium, and to the *dryness of the atmosphere.* Nothing could better corroborate the latter in the meteorological registers than the coincidence in the difference between Bengál and the Pănjáb, Síkkim and Tíbet. In consequence, also, the precipitation of dew depriving the atmosphere of a considerable part of its moisture, must cause a proportional increase of radiation; this too could be traced, by the daily variation, the better in regions where, like in Tíbet, the precipitation of dew reduces the absolute moisture to a very minimum.

Professor TYNDALL[2] obtained results quite analogous by a very different series of observations. He had found that heat from whatever source, in passing through hydrogen, oxygen, nitrogen, or even dry air, finds but very little resistance; glass and other solid substances easily permeable to solar heat, offer great resistance to the passage of heat radiating from dark bodies; and his researches added the dis-

[1] Figured in the Physical Geogr. of the Alps, Vol. I, plate X.

[2] TYNDALL, 1863, Transact. Royal Soc., Philos. Magazine, &c. Here I must limit myself to the principal values he obtained, without entering into the method he employed. The researches of Prof. MAGNUS, Pogg. Annal 1864 differ in the results obtained. My observations of insolation and radiation in tropical climates, however, based upon the registers from 1854 to 1858, as well as the details sent into Parliament in 1863, are in perfect analogy with Professor TYNDALL's experimental results.

covery that many gases and vapours possess the same quality of intercepting the heat from sources not luminous, of absorbing and later radiating heat themselves. If for the vacuum absorption of heat from a body at 212° Fahr. is 0, and if we call it 1 for the dry atmosphere, it was found 9 by him for carbonic acid, 403 for hydrocarbonic gaz, 970 for olefient gas and 1195 for ammoniac. The small quantity of ozone in electrolytic oxygen was found to raise its absorbing power from 1 to 85, even to 136: the aqueous vapour in the air at the ordinary temperature produces an absorption varying from 70 to 80. Air *saturated* by humidity at the ordinary temperature absorbs more than 5 per cent. of the heat radiated from a metallic vessel filled with boiling water; and TYNDALL has calculated that of the heat radiated from the surface of the earth after its being heated by the sun, 16 per cent. is absorbed by aqueous vapour in the first 10 feet.

As equally shown by these important experiments the share of moisture in climate and in the modification of temperature, by its influence upon radiation, can be compared with the protection of a hotbed, or a vertical wallcase for fruit-trees; it allows the solar rays to heat the surface of the earth, but to a certain degree a temporary accumulation of heat and a more uniform and gradual cooling is the consequence.[1]

[1] Also the gradual variation of the quantity of carbonic acid at different heights may be thought of here. In the present geological period its absolute quantity is very small, but as SHERRY HUNT recently has observed, Philos. Magazine, October 1863, there is strong reason to believe from the quantity of carbonate of lime and coal that in former geological periods a considerable quantity of carbonic acid must have been mixed with the atmosphere and this circumstance, acting like a protecting cover of glass may have materially contributed to prolongate the high temperature on the surface of our globe.

I had already found, together with ADOLPHE, that in the Alps it increases with height, the quantity, however, remaining very small altogether; from the basis of the Alps up to the Vincentpyramide (one of the peaks of Monte Rosa) 13,838 Eng. feet, we had found it to increase from 4 to 9·5 parts in 10,000. "Phys. Geogr. of the Alps," vol. I., p. 455 to 466, vol. II., p. 175 to 184. The experiments in the Himálaya and Tibet, though they cannot be detailed here, may be mentioned, to allow of my saying that the results perfectly confirmed the increase with height; and in analogy with the modifications observed in the Alps, it became somewhat more rapid in heights where the forms of elevated narrow ridges and isolated peaks began to predominate, or when vegetation had nearly disappeared. The absolute values had but little exceeded the maxima we formerly had found in the Alps, notwithstanding the considerable difference in the absolute heights.

Philos. Magazine, October, 1863.

From experiments I have recently made in my wallcase at the Jägersburg, even practical application may be expected by filling them with air considerably mixed with carbonic acid; this can easily be procured by combustion. In many parts of Franconia, smoke, and rather as TYNDALL's experiments explain it to have a share in it, carbonic acid, is used for preventing or at least diminishing the deleterious effect of nocturnal radiation upon the germination of the vines early in spring. During very clear and cool nights fires are lighted in the vineyards "for protection," though much too small to sensibly affect the temperature.—Concerning the additional modification of nocturnal radiation by the *form* of the surface, including the structure of various bodies exposed, compare the well-known experiments by GLAISHER, Phil. Transact., II., p. 119—217.

HEAT TRANSMITTED FROM THE MOON.

The heating power of the sun may be still considered in reference to the indirect influence exercised by heat transmitted from the moon. As Sir John Herschel[1] has already explained in detail, it is very probable that the surface of the moon, from its day being nearly 30 times as long than ours, attains a temperature exceeding that of boiling water; Althaus[2] even approximatively deduces a temperature four times that of boiling water, seven days after full moon, followed by a depression of 940° Fahr. (522° C.) about half a day after new moon. More positive, however, it is, that till Melloni[3] employed his most delicate thermoscopic apparatus, no trace of heat was positively *observed* to reach the surface of the earth, not excluding, nevertheless, an opinion held by many astronomers,[4] viz. that the thermic rays radiating from the moon may reach the upper limit of our atmosphere in appreciable intensity, and may so participate in the dissolving of clouds, especially cirri, with the rising full moon.

The direct effect of the moon upon the thermometer on the surface of the earth cannot be expected to be quite inappreciable; but the various researches made till now show results so materially differing, that a very long series only allows of our defining these modifications. Mädler, employing, however, 15 years only of Berlin observations, had found the maximum to take place two days before the first quarter, the minimum three days after the last quarter.

Buys-Ballot, from 114 years of observations in the Netherlands,[5] combined in reference to the age of the moon on the respective days, had obtained that about full moon this mean is nearly 0·2° Fahr. warmer than about new moon.[6]

The recent researches of Park-Harrison,[7] based upon about 16,000 daily means from 1814 to 1856 (43 years), have shown as one of the principal results in reference to these questions, that a rise of mean temperature is more frequent at new moon

[1] "Outlines of Astronomy," p. 261.

[2] Pogg., Ann., 90, p. 551. He admits, in these considerations that the capacity of heat on the surface of the moon should be comparable, *e. g.*, to that of quartz.

[3] Compt. Rend., T. 22, p. 541. The same results were obtained, in July 1850, by Piazzi Smyth on the Peak of Teneriffe.

[4] Fechner, "Prof. Schleiden and the Moon," Leipzig, 1856, p. 180.

[5] Bär and Mädler, "Der Mond," Berlin, 1837, p. 165.

[6] Pogg., vol. 70, p. 163.

[7] Presented by Mr. Faye in the French Academy; "Cosmos," 1863, p. 674.

and during the first quarter than near full moon[1] and in the last quarter; the depression of mean temperature can be traced to coincide frequently with the last quarter.[2]

It is evident that for questions where the observations in Europe scarcely offer materials rich and accurate enough, the various hypotheses on the influence of the moon upon temperature and weather we occasionally meet in the Journal of the Asiatic Society[3] cannot be considered sufficiently well defined to be discussed at here.

Believers in the connexion of lunar age with heat and rain and wind, in one or the other form, we meet with all over the globe, the most savage tribes not excluded; but the latter, notwithstanding a kind of instinct being generated for many a detail of physical phenomena, by a constant contact with nature, we invariably find the most unhappy in their mystical interpretation of more delicate materials. What first must have drawn man's attention to the action of the moon upon our globe is the influence of her gravitation, so decidedly seen in the tides; but recent science, La Place[4] at its head, has sufficiently proved that for the atmosphere such action must be reduced to a very small amount, though this influence is decidedly traceable.[5]

NUMERICAL DATA AND DESCRIPTIVE REMARKS TO ILLUSTRATE THE HOURLY OBSERVATIONS.

For illustrating the changes of temperature within the *daily and yearly period* the materials are numerous enough. The Indian observations quoted above contain many years already, for the climate of the coasts; and my own observations, supported by the assistance of Dr. Tritton, provided me also for the continental part of India

[1] This better agrees with Mädler's results; the difference from those obtained by Buys-Ballot, Mr. Harrison thinks, must proceed from the circumstance that the observations which formed his material were nearly exclusively based upon means deduced from observations made during daytime, and not offering positive materials of nocturnal observations.

[2] Even this might be considered as not necessarily in contradiction with Melloni's positive data, supposing that a dissolution of vapours in the higher strata was the first effect, succeeded by a more vivid radiation from the surface of the earth. At the same time it shows how much care is necessary in theoretical interpretations.

[3] Middleton and Beale, 1851 and 1852, &c.

[4] "Méchanique céleste," Livre XIII; Cap. VII.

[5] I particularly allude to the careful researches of General Sabine on the lunar atmospheric tide at S. Helena, Phil. Trans. Royal Society, 1847, followed in 1851 by analogous results obtained by Captain Elliot at Singapúr. Phil. Trans., 1852.

with materials which easily could to be completed so as to present a corresponding series for Ambála. For the Himálaya and Tíbet the *hourly* observations remained limited to shorter periods; for the *annual* variation, however, several stations could be compared. In the manuscripts I obtained from the Medical Board, not unfrequently hourly observations were made the 21st. to 22nd. of various months as proposed by the Court of Directors. But in general isolated days at stations far distant from neighbouring observatories did not show materials sufficiently important to be reproduced here in full detail. Also the hourly observations we had occasion to make ourselves in India are only mentioned occasionally for comparison, unless they include a longer period, such as at Ranigánj.

The following table contains (where possible, throughout for the year 1855):

I. The hourly observations of temperature at Bombay day by day for one year. I selected Bombay for these details which for one station were unavoidable for giving the full type, since its position allows one to consider it at the same time as very little differing from the climate of tropical islands and seas.[1]

II. The mean daily variation month by month for the whole year for Bombay, Madrás, Calcutta, Ambála.—For Madrás the latest year I obtained in detail was 1850; the standard I had found when comparing it in 1855 with my Kew Instruments to be 0·98° Fahr. too high, therefore 1° Fahr. is deduced from the original readings. The hours are referred to the Göttingen full hours; noon therefore becomes 4h 41m P.M., &c.: this explains the addition of 41 minutes to the full hours of local time.

Hourly observations within smaller periods for the mountains Tónglo and Falút in Síkkim, and for Islamabád in Kashmír; and hourly observation for August 1856 for Leh in Ládak are to follow; as the meteorological features of the mountainous regions altogether have a character of their own so materially differing in many respects from the tropics, I preferred to speak of the daily variation later, together with the other data for the meteorology of High Asia.

The curves are added in Plate 4 of the Meteorological Atlas:

[1] These observations in 1855, as well as during the following years, I regularly got sent after from the Kolába Observatory. They formed a very precious set of corresponding observations during our travels.

BOMBAY. Lat. North 18° 53′·30″; Long. East Green. 72° 49′·5″; Height

[1] 1855. Hourly readings of

January. A. M.

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	74·2	74·2	73·0	72·2	71·2	72·7	73·7	73·0	76·0	77·4	78·4	79·5
2	75·0	74·0	73·6	72·6	73·0	72·2	71·4	71·2	73·5	76·2	77·3	79·0
3	74·5	74·5	73·2	72·0	73·0	72·0	71·5	70·8	72·3	76·0	79·0	81·4
4	71·0	70·4	70·0	70·0	70·0	70·2	69·5	69·2	70·5	73·4	75·6	77·2
5	70·2	69·7	68·0	69·6	69·0	67·6	66·0	68·0	70·0	73·2	74·6	75·4
6	71·7	71·0	70·7	70·8	70·2	69·8	69·3	69·2	71·5	73·7	75·2	76·0
7												
8	72·2	71·6	70·6	70·6	70·4	69·0	68·5	68·8	71·2	73·0	74·3	76·0
9	71·2	71·2	70·6	70·4	70·2	69·4	69·2	69·1	71·3	74·0	76·7	77·0
10	74·0	73·6	73·2	73·0	72·5	72·5	71·2	72·0	72·0	76·0	78·0	79·0
11	70·8	71·0	71·2	70·6	70·0	70·0	70·4	70·0	72·2	72·4	73·5	75·8
12	70·7	69·2	69·0	68·0	69·0	69·0	68·4	69·4	70·4	72·6	74·0	75·8
13	71·7	69·0	70·0	69·4	69·2	69·0	69·4	69·0	71·7	71·4	74·0	77·0
14												
15	67·0	66·0	65·0	65·0	66·0	66·2	66·2	66·3	68·0	71·0	73·8	74·7
16	66·5	66·4	65·2	64·5	64·0	63·3	62·3	63·5	68·3	71·0	73·2	75·2
17	67·2	66·0	65·0	63·5	63·5	62·6	63·3	64·0	67·0	70·7	71·2	73·6
18	66·5	65·5	64·8	64·4	63·0	62·0	61·0	60·0	63·0	67·0	70·3	72·2
19	62·4	67·0	66·0	67·5	66·0	64·3	65·4	66·4	68·3	71·6	74·3	77·2
20	73·0	73·6	73·4	73·0	73·0	72·2	72·0	72·5	74·5	76·5	78·8	81·4
21												
22	76·2	75·5	75·0	74·6	74·6	74·0	73·3	73·0	75·6	77·3	79·2	81·0
23	76·0	75·0	74·4	74·0	73·2	74·0	73·4	73·3	74·6	77·8	80·4	82·0
24	75·4	75·0	75·0	75·0	74·6	74·3	74·2	74·5	76·8	80·3	80·2	86·0
25	73·0	73·0	73·6	73·4	73·4	73·4	72·5	73·0	75·2	77·0	79·2	83·0
26	73·4	73·4	72·4	72·0	72·0	71·4	71·5	70·5	73·5	76·4	77·7	80·4
27	73·0	72·0	70·6	70·4	70·2	70·0	70·0	70·5	73·2	75·3	78·0	80·0
28												
29	72·3	72·0	70·3	68·0	67·7	67·0	68·8	69·2	72·0	74·2	76·4	78·4
30	71·0	70·4	71·0	70·0	68·4	68·2	68·2	69·4	73·2	74·0	77·0	78·0
31	71·4	70·8	71·0	71·7	71·2	69·6	68·0	69·0	74·2	76·0	77·1	80·0

[1] For the monthly means of the

(position of the instruments at the government observatory) 38 feet.

temperature, day by day.[1]

January. P.M.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
81·4	83·4	84·2	85·0	84·8	83·0	79·2	78·4	78·0	76·8	76·3	75·7
81·0	82·3	84·0	84·4	84·2	81·4	78·3	76·3	75·0	76·4	76·4	75·8
82·3	82·3	81·6	81·2	80·0	77·5	75·2	74·5	74·3	73·0	71·2	71·4
79·4	80·8	81·0	81·0	80·0	77·4	75·2	74·3	73·5	72·2	70·8	70·5
77·0	78·2	79·6	80·2	80·6	78·3	75·3	73·5	73·0	72·8	71·7	72·0
76·5	79·0	79·4	79·2	80·2	78·3	74·5	74·2	73·5	72·4	71·5	71·2
77·2	78·7	79·6	80·0	79·6	77·5	75·0	74·2	73·5	73·0	72·7	72·0
77·2	78·6	80·0	80·4	82·0	80·4	77·0	75·5	74·8	75·0	75·2	75·0
79·0	79·4	80·2	81·7	80·0	79·2	76·4	76·0	75·0	74·6	73·6	71·2
77·3	78·0	78·4	78·2	78·2	75·2	72·3	71·8	71·8	71·2	70·5	70·4
77·0	77·3	78·3	79·4	79·3	77·4	74·4	73·8	73·0	72·4	72·4	72·4
77·8	77·4	77·4	77·4	76·8	75·0	72·0	71·4	70·8	70·0	68·2	67·0
77·2	79·2	80·0	80·2	80·0	78·4	74·4	73·3	72·5	70·4	69·2	68·3
77·0	78·5	78·4	78·4	78·4	76·2	72·4	71·4	71·2	69·2	68·2	67·7
75·2	76·0	77·5	77·6	77·0	75·4	71·4	70·4	70·3	70·0	68·3	67·2
75·3	76·0	77·2	77·8	77·4	75·0	72·3	71·4	70·8	69·7	69·0	68·2
81·0	83·4	86·0	85·2	81·6	79·0	75·4	74·2	73·4	73·2	72·0	70·7
83·5	86·0	87·0	84·4	83·5	81·2	76·8	75·4	75·4	75·4	75·0	74·2
84·4	87·0	86·7	87·0	86·2	84·5	80·5	78·3	77·5	77·0	76·5	76·3
85·3	84·6	86·4	85·0	84·0	82·2	80·0	78·6	77·6	77·2	77·0	76·2
88·2	86·6	86·8	86·2	83·1	80·8	78·2	77·2	76·5	76·0	75·2	74·3
88·0	86·0	87·4	85·4	84·4	80·6	78·2	77·0	77·0	76·4	75·2	74·7
83·6	86·2	85·8	85·0	83·6	82·2	78·4	77·0	76·4	75·0	74·0	73·2
80·6	81·4	82·4	82·6	81·6	80·2	76·6	75·6	75·3	76·2	73·0	72·0
81·0	82·0	82·2	82·7	82·3	81·0	77·6	76·0	75·6	74·3	72·3	71·8
80·0	81·7	82·8	83·2	82·0	81·0	78·0	76·6	75·6	75·0	73·4	72·7
81·0	82·0	83·2	83·8	83·8	81·8	78·6	77·6	76·4	75·4	74·4	74·4

hourly readings see the tables in Chap. V.

February. A. M

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	74·0	73·2	71·6	71·0	70·6	70·2	68·8	68·8	74·0	76·0	77·9	80·0
2	73·0	74·0	73·8	74·0	73·0	71·4	70·0	70·0	74·0	77·0	79·0	80·9
3	74·3	74·0	71·5	70·5	70·4	70·0	70·2	68·8	73·0	75·0	77·0	79·0
4												
5	73·0	73·2	72·4	73·2	73·0	72·0	71·8	70·3	71·5	74·2	75·6	77·4
6	71·2	71·0	71·0	71·0	71·0	71·0	70·6	70·2	72·8	75·2	77·9	79·6
7	75·3	74·4	74·0	74·0	74·0	73·0	73·2	73·4	74·2	77·5	80·6	83·3
8	76·5	76·0	74·7	74·5	74·0	73·7	73·4	75·0	77·0	77·5	77·2	77·4
9	75·3	75·0	75·5	75·8	75·8	75·8	74·0	74·0	75·0	77·5	79·2	80·6
10	74·2	75·0	74·4	74·0	74·0	72·0	71·7	71·0	74·0	77·2	80·3	82·6
11												
12	75·3	76·0	75·5	74·7	74·0	73·5	72·4	72·8	73·0	75·2	78·4	80·0
13	75·0	74·4	73·2	73·0	72·4	71·0	72·0	72·2	75·5	78·4	80·0	82·3
14	74·7	75·0	74·2	73·2	72·4	71·5	72·0	73·4	74·7	77·3	79·6	82·0
15	76·3	76·0	75·0	74·6	74·4	73·4	74·6	75·0	77·4	79·0	80·3	81·5
16	74·3	75·7	75·4	75·2	75·0	75·0	74·8	75·0	76·7	79·0	81·0	82·0
17	76·3	76·7	76·4	76·0	76·0	76·0	76·0	76·2	77·3	80·2	82·2	83·0
18												
19	72·0	70·6	72·2	72·2	71·4	71·2	70·8	71·0	74·0	76·0	77·5	79·0
20	71·8	71·0	71·0	72·0	71·2	71·2	70·6	71·4	73·6	75·4	77·4	79·0
21	72·2	72·8	73·0	73·5	72·3	71·2	71·2	72·0	75·6	77·3	78·2	79·2
22	73·3	72·0	72·0	71·5	72·0	71·8	72·0	72·6	76·0	77·3	78·5	80·3
23	74·4	74·0	73·2	72·0	71·4	71·0	71·0	72·0	74·4	76·2	78·0	79·3
24	72·4	72·0	71·0	70·4	70·2	70·5	70·8	71·2	73·6	76·2	78·0	81·0
25	72·0	71·2	70·0	70·4	73·0	70·5	69·4	70·0	74·5	79·8	81·0	82·4
26												
27	73·5	73·3	73·3	72·5	71·5	72·0	71·7	73·0	75·2	77·6	78·4	80·6
28	73·0	72·0	72·0	72·2	71·4	70·5	70·0	71·0	75·0	76·4	78·0	80·0

February. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
81·8	82·7	84·0	84·0	83·2	82·0	78·4	77·4	76·4	76·2	75·0	74·0
82·0	83·3	84·2	84·4	83·8	83·0	78·2	77·0	76·0	75·0	74·0	74·5
81·0	82·2	83·0	82·0	81·2	80·0	76·6	75·0	74·8	74·2	74·0	73·0
79·9	81·3	81·6	82·0	81·8	80·2	77·2	75·8	75·0	74·5	72·5	72·0
81·5	81·8	83·0	83·7	84·2	82·8	79·4	78·0	77·2	76·5	76·2	75·8
84·3	85·8	86·2	86·2	86·0	83·8	80·6	79·6	78·6	78·2	77·5	76·5
82·0	84·0	87·2	85·5	86·2	82·6	81·0	79·4	78·6	78·0	77·0	75·8
82·0	82·2	82·7	82·4	82·0	80·6	78·2	77·0	76·4	76·2	75·4	75·2
84·0	83·7	83·5	83·4	82·7	80·0	78·0	77·2	77·0	76·7	75·4	75·4
82·4	83·4	84·0	82·2	83·4	81·4	79·0	78·6	78·0	77·4	76·2	75·3
83·4	84·0	84·4	84·7	84·4	83·2	79·6	78·5	77·4	76·3	75·0	74·5
84·0	85·4	85·0	84·4	83·4	82·6	79·6	78·4	77·6	77·0	75·5	74·5
83·2	84·4	85·0	85·4	85·0	81·6	80·0	78·0	77·2	76·4	75·0	74·5
82·4	84·2	85·0	84·4	84·7	81·0	80·0	78·2	78·0	77·4	76·6	76·5
81·5	82·5	84·2	82·4	81·2	79·8	78·0	77·0	76·2	76·0	75·5	75·2
80·2	81·0	82·4	82·3	81·2	80·0	77·2	75·0	74·0	73·5	73·2	72·8
79·8	81·6	83·0	83·2	82·4	81·2	78·2	76·4	75·6	74·8	74·3	72·8
80·3	81·7	82·6	83·0	82·7	80·0	77·0	76·4	76·0	74·5	74·0	73·5
81·0	82·4	82·0	81·4	81·0	79·6	77·6	76·0	76·0	75·3	74·6	74·4
81·4	82·2	82·0	82·8	81·6	81·0	77·6	76·8	76·0	75·5	75·0	74·3
82·2	82·3	83·0	83·0	82·0	80·8	78·0	77·0	77·0	76·4	73·0	72·4
83·8	84·0	84·0	83·8	83·0	81·8	78·4	77·6	77·0	76·6	76·5	74·5
81·4	83·0	84·2	84·3	84·7	85·0	80·2	77·3	76·0	75·6	75·0	73·4
81·2	82·3	83·2	83·8	82·4	79·4	77·8	76·3	75·7	75·0	74·6	73·6

March. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	72·4	72·0	72·0	71·0	71·2	70·8	71·2	71·8	75·0	77·0	80·0	80·0
2	71·0	70·5	70·3	70·2	70·0	70·4	70·5	71·0	73·3	75·0	76·6	78·6
3												
4												
5	76·5	75·0	74·0	74·2	74·5	74·2	74·0	75·4	79·0	81·6	82·6	84·8
6	75·5	76·2	75·5	75·2	75·6	74·7	74·4	75·5	79·2	80·5	83·0	84·6
7	76·0	76·2	77·0	76·2	75·8	75·4	74·7	75·0	78·0	80·0	82·2	83·2
8	75·0	75·0	74·5	74·3	74·2	73·0	73·0	73·2	74·7	78·6	81·0	82·6
9	74·6	74·3	74·3	73·8	73·5	73·2	72·8	73·3	74·4	76·0	78·0	79·5
10	68·0	68·0	68·0	67·5	67·3	67·2	68·2	69·0	71·4	73·2	76·2	77·8
11												
12	74·4	73·0	72·5	73·0	72·6	71·8	71·4	74·3	77·2	79·7	82·8	88·2
13	77·4	76·4	76·2	76·0	75·8	75·2	75·0	75·4	78·2	80·6	82·5	83·5
14	76·6	76·4	76·3	76·2	75·6	75·7	75·6	77·0	79·3	81·2	82·6	83·6
15	75·0	74·5	74·3	74·5	74·4	75·0	75·0	76·2	78·8	80·8	81·8	82·8
16	75·0	74·4	74·3	74·3	73·0	72·0	72·4	74·4	77·0	75·4	81·8	82·8
17	74·8	74·4	74·0	72·8	72·0	71·0	71·4	74·2	77·3	79·6	81·4	82·2
18												
19	78·4	77·4	77·0	76·4	76·5	76·3	76·2	76·0	81·0	84·0	85·8	87·0
20	78·6	78·5	78·5	77·4	77·3	78·0	75·0	77·2	82·5	84·0	86·8	88·2
21	77·8	76·5	75·3	74·2	74·0	74·0	74·6	77·0	81·4	84·2	85·0	86·0
22	76·5	77·4	77·0	76·0	75·2	74·2	74·5	76·6	80·0	82·6	84·2	84·6
23	76·4	77·2	77·0	76·4	75·4	74·4	74·0	77·0	79·8	81·6	83·6	85·0
24	77·0	76·0	75·0	76·2	76·4	76·2	76·0	77·7	82·2	86·4	89·5	90·9
25												
26	78·5	78·0	77·5	76·5	75·4	75·0	74·6	77·8	81·2	83·8	84·8	86·2
27	78·0	77·4	77·0	76·5	76·0	75·8	75·5	77·6	80·0	82·0	84·0	85·8
28	78·2	77·5	77·3	77·2	76·2	75·4	75·6	77·8	80·8	84·0	85·6	85·4
29	77·6	77·2	77·0	76·5	76·2	75·0	75·0	77·0	80·0	83·0	84·0	84·8
30	75·4	75·2	75·2	75·0	74·0	73·8	74·0	76·4	79·4	82·0	83·6	84·0
31	76·5	76·5	76·2	75·2	75·0	75·0	75·2	78·0	80·0	82·0	83·6	85·3

March. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
80·6	81·2	81·3	81·2	80·4	79·2	75·8	74·5	74·0	73·5	73·0	72·0
78·6	80 3	80·3	79·4	79·3	77·2	75·0	73·2	72·5	72·0	72·0	71·4
85·8	86·6	88·0	88·7	89·0	87·0	82·7	80·4	79·0	78·0	77·0	77·2
87·2	87·5	88·0	87·0	85·3	83·0	80·4	79·0	78·2	78·0	77·0	76·5
83·4	84·0	83·5	83·2	82·7	81·2	78·2	77·0	76·7	76·2	76·0	75·0
82·6	83·0	82·5	82·4	82·4	81·2	78·0	76·8	76·2	75·8	75·2	75·0
80·0	79·7	79·5	79·2	78·4	76·5	73·2	71·8	71·0	71·0	70·6	69·0
80·0	80·6	81·0	81·0	81·0	79·0	76·0	75·0	74·3	74·2	72·4	71·3
92·5	93·3	91·0	89·4	88·8	86·6	82·4	80·5	80·0	79·0	78·5	78·0
84·4	84·5	86·0	86·3	84·5	83·4	80·3	79·4	79·0	78·0	77·5	77·0
85·6	86·3	86·5	86·8	84·5	82·0	79·0	78·0	77·2	76·2	76·2	75·3
83·5	83·6	84·2	84·0	83·4	81·4	78·2	77·0	76·4	76·0	75·6	75·4
83·0	83·4	84·2	84·2	83·4	81·0	78·0	76·4	76·0	75·4	75·0	75·0
84·2	84·5	84·5	84·5	84·3	83·2	80·3	79·2	78·9	78·9	78·5	76·6
88·8	90·2	90·2	90·0	89·4	87·0	83·7	82·0	81·2	80·6	78·6	76·4
89·4	89·8	90·0	89·0	87·6	85·6	82·2	80·8	80·0	79·4	78·8	78·3
86·4	87·2	87·4	87·4	87·0	85·2	81·5	80·0	79·2	78·4	78·2	77·7
85·4	86·2	87·2	88·2	87·0	84·5	81·0	79·4	78·4	77·6	76·6	76·0
85·4	86·5	80·0	87·8	86·5	84·8	82·0	80·5	80·0	79·0	78·4	77·6
91·0	91·3	91·0	90·8	89·5	87·2	84·5	84·0	83·5	82·0	80·4	79·5
87·8	86·8	87·2	87·2	86·8	84·5	81·8	80·0	79·2	78·8	78·5	78·2
88·6	88·2	88·8	88·7	87·4	85·4	82·3	80·7	80·0	79·6	79·0	79·0
86·0	86·4	86·2	85·8	85·2	83·4	80·6	79·4	79·0	78·4	78·0	77·6
85·3	85·4	85·5	85·0	84·2	82·4	79·2	77·7	77·2	76·6	76·0	77·0
85·2	85·3	85·3	85·0	83·5	82·0	79·5	78·0	77·6	77·2	76·9	76·6
86·2	86·8	86·8	86·0	85·0	83·2	81·0	71·4	79·0	78·5	78·3	78·3

April. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1												
2	77·4	77·2	76·8	76·6	76·4	75·0	74·8	77·8	80·6	82·8	85·0	86·0
3	78·0	77·1	76·5	76·4	75·8	74·5	74·3	77·5	80·3	82·6	83·8	85·0
4	76·3	75·9	75·5	75·8	75·4	74·3	74·3	76·4	79·8	82·3	83·4	84·0
5	77·2	77·6	77·6	75·4	74·6	74·5	74·5	78·2	81·2	82·6	83·8	84·9
6												
7	76·0	75·5	75·0	75·4	75·0	75·2	74·4	77·0	79·6	81·4	82·5	83·4
8												
9	78·4	77·7	76·4	76·0	75·2	74·3	74·0	77·8	81·5	85·2	86·0	86·8
10	78·5	77·7	77·8	78·2	78·2	77·8	77·5	79·2	81·4	84·2	85·4	86·6
11	79·8	79·5	78·5	78·2	78·0	77·8	79·2	81·2	84·0	88·0	91·3	92·5
12	81·2	80·6	80·6	80·0	79·5	79·4	79·2	82·3	84·2	87·0	88·8	89·4
13	79·2	78·5	78·0	77·6	76·4	76·2	76·0	78·7	82·5	85·5	86·8	87·0
14	74·7	75·8	76·0	75·5	74·2	73·5	73·8	77·5	81·2	83·8	85·4	85·8
15												
16	77·2	77·0	77·0	76·4	75·2	74·3	74·3	77·5	81·0	84·0	86·0	86·5
17	77·7	77·5	77·4	77·0	76·8	75·7	75·4	79·0	81·8	84·8	87·3	88·0
18	79·0	78·6	78·3	78·1	77·8	77·8	77·2	81·3	83·3	85·0	86·6	87·7
19	79·0	78·8	78·6	78·5	78·4	78·3	78·0	81·5	83·0	85·6	86·8	87·8
20	79·0	78·6	78·5	78·3	78·0	77·2	76·4	77·5	79·8	84·4	86·2	87·4
21	78·0	78·4	77·8	76·8	76·0	75·6	76·2	80·2	83·2	85·2	86·4	87·8
22												
23	79·0	78·8	78·6	78·2	77·7	76·5	76·8	78·6	80·0	83·0	84·7	86·8
24	79·4	79·4	79·2	78·6	78·4	78·2	78·2	81·6	84·0	84·6	87·0	87·4
25	79·4	79·0	78·6	78·5	78·4	78·2	78·6	82·3	85·0	87·0	86·0	87·7
26	79·4	79·4	79·2	79·0	78·8	78·4	78·6	81·3	84·5	86·0	87·5	88·7
27	80·2	79·8	79·2	79·7	79·2	79·0	79·0	82·4	85·5	87·4	87·7	88·6
28	80·0	79·8	79·6	79·2	78·4	77·5	77·4	80·6	83·4	87·4	88·8	88·2
29												
30	81·3	81·0	80·7	80·3	79·4	79·4	79·8	82·6	84·8	89·0	90·2	91·0

April. P. M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
85·8	85·5	86·2	87·0	85·5	84·4	81·3	79·3	78·8	78·2	77·8	77·7
86·2	86 7	86·5	86·6	84·3	83·0	80·3	78·6	78·2	77·4	77·2	77·0
85·2	84·6	84·8	85·4	85·0	85·8	83·3	79·9	78·4	78·0	77·4	77·2
85·0	86·4	86·4	85·6	84·0	82·4	79·7	78·2	77·6	79·2	76·4	76·8
85·0	85·4	85·6	85·4	83·6	81·0	79·0	78·4	77·6	77·0	76·4	76·0
88·0	88·7	89·5	89·8	88·8	87·2	83·4	81·5	80·8	80·2	79·0	78·8
88·0	88·0	88·8	90·0	87·2	84·8	82·4	81·8	81·4	81·0	80·2	80·0
93·2	93·0	92·6	90·2	89·0	86·4	83·8	83·2	83·0	83·0	82·0	81·7
89·8	89·5	89·5	88·5	87·6	85·0	82·7	81·2	81·2	80·5	80·0	79·8
87·2	87·6	87·0	86·0	84·8	83·4	80·0	78·5	78·0	77·5	77·4	76·0
86·4	86·4	86·4	86·0	85·0	83·0	80·6	79·4	78·5	77·7	77·5	77·4
87·8	86·5	86·0	86·0	85·3	83·2	80·5	79·2	78·7	78·4	78·2	78·0
88·2	88·3	87·2	86·6	86·5	84·5	82·2	80·3	79·8	79·4	79·2	79·2
87·4	87·1	87·2	86·8	85·8	83·2	81·2	80·0	79·4	79·0	79·0	79·2
87·6	88·7	87·8	88·4	87·8	85·2	82·8	81·0	80·3	79·7	79·4	79·2
88·4	89·2	88·4	89·2	88·0	84·4	82·2	80·8	80·2	79·4	79·0	79·0
89·0	89·2	89·6	89·9	88·2	86·4	83·0	81·0	80·2	80·0	79·0	79·0
87·8	88·9	89·3	89·3	88·2	85·6	82·8	82·0	81·0	80·2	80·0	79·6
88·4	89·1	89·1	88·4	87·5	84·8	82·8	81·3	80·8	80·3	80·0	79·4
89·0	89·6	89·5	89·0	87·6	84·6	82·4	81·3	80·8	80·4	80·2	80·0
89·7	90·2	90·0	89·9	89·0	86·7	83·8	82·2	81·4	81·2	81·0	80·4
89·0	89·2	88·8	88·4	87·6	85·0	82·5	81·4	81·0	80·4	80·2	80·2
90·0	89·9	88·8	88·5	87·4	85·7	83·8	83·0	82·5	82·3	82·0	81·5
91·4	91·2	90·4	89·7	89·2	87·2	84·8	84·0	83·1	82·3	81·3	81·4

May. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	81·2	81·0	80·5	80·2	79·7	79·4	80·0	83·8	84·5	86·7	88·3	89·5
2	81·4	81·0	80·8	80·6	80·0	79·6	80·0	84·4	87·0	88·6	90·0	90·5
3	82·2	82·0	82·0	81·0	80·0	79·7	79·4	83·2	87·2	91·0	92·2	92·3
4	82·0	87·8	81·5	81·0	81·2	81·4	80·8	84·2	85·8	87·2	88·3	89·5
5	80·0	81·3	81·2	81·0	80·8	80·8	81·2	83·2	86·2	87·5	89·0	89·8
6												
7	82·3	82·0	81·8	81·7	81·5	81·8	82·0	82·8	85·2	85·2	86·2	90·3
8	82·4	82·0	81·0	81·4	81·0	80·8	80·8	83·2	86·0	88·2	89·7	90·8
9	82·0	89·2	80·4	80·2	80·7	80·8	81·8	84·2	88·8	85·4	89·0	91·2
10	83·0	82·7	82·4	82·4	82·7	83·0	83·3	85·9	87·4	89·0	91·4	92·5
11	82·0	81·4	80·6	80·5	81·2	81·4	81·8	83·4	87·7	88·3	90·3	89·6
12	82·0	81·6	81·5	81·0	80·0	79·3	80·2	84·2	87·0	88·5	89·5	91·0
13												
14	82·9	81·6	81·4	81·3	81·0	80·0	80·7	84·9	86·4	86·5	89·0	90·3
15	81·2	81·0	80·6	80·4	80·2	80·0	80·2	83·8	88·6	88·0	89·0	90·4
16	82·4	82·4	82·2	81·6	81·4	81·2	81·4	83·4	87·2	89·4	90·4	91·0
17	82·5	82·2	82·0	81·7	81·4	81·4	82·0	83·5	85·2	87·8	89·8	90·5
18	82·2	82·0	81·8	82·0	81·5	81·8	82·4	83·4	86·0	86·6	89·4	90·6
19	83·0	82·4	82·0	81·8	81·4	81·5	82·2	85·4	86·5	89·0	90·4	91·5
20												
21	82·8	82·4	82·2	82·0	82·0	81·8	82·0	83·7	87·4	88·3	89·6	90·2
22	82·6	82·5	82·4	82·4	82·4	82·0	82·8	84·4	87·7	88·4	89·4	91·5
23	83·4	83·0	82·5	82·4	82·3	82·4	82·9	84·3	87·4	89·2	90·0	91·0
24												
25	83·0	82·8	82·5	82·2	82·0	81·7	82·8	84·0	87·8	89·8	90·9	92·0
26	83·0	82·7	82·0	81·8	80·5	80·2	81·0	84·0	86·8	89·0	90·4	91·5
27	83·0	82·4	82·2	82·0	82·0	81·8	82·6	85·5	88·0	89·2	90·5	91·3
28	83·0	82·5	82·4	82·4	82·2	82·2	82·6	84·8	87·6	89·6	91·0	92·0
29												
30	82·7	82·8	82·5	82·0	82·0	82·0	82·8	86·4	88·3	90·2	91·3	92·5
31	83·3	83·1	82·1	82·0	82·0	81·6	82·6	85·3	87·7	89·2	90·0	91·2

May. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
90·3	90·8	90·0	90·0	88·8	87·4	84·9	83·2	82·5	82·3	82·2	82·2
91·5	91·5	92·0	92·3	91·4	87·6	84·6	83·0	82·8	82·8	82·5	82·3
93·3	92·0	92·0	90·7	89·5	87·5	85·5	84·9	83·2	82·6	82·3	82·0
90·3	90·7	91·2	90·0	90·0	87·5	85·4	84·2	83·1	82·7	82·0	82·3
91·0	91·3	91·2	91·5	90·5	87·8	86·5	84·4	83·5	83·2	83·2	83·2
91·8	92·5	92·8	92·0	91·2	89·4	86·0	84·0	83·6	83·2	82·8	82·4
91·8	92·2	92·7	92·5	91·8	89·3	86·4	84·6	84·0	83·5	83·0	82·4
92·2	92·8	93·2	93·0	92·0	89·6	88·6	84·8	84·4	84·0	83·3	83·0
93·2	93·2	93·2	92·4	91·0	88·4	85·7	84·3	83·8	83·3	82·5	82·0
88·4	87·7	91·0	91·8	91·4	89·2	86·3	84·4	83·2	82·5	82·5	82·3
91·6	92·0	92·3	91·8	91·3	89·4	86·4	84·4	83·4	83·0	82·6	82·4
91·4	92·0	91·0	91·2	90·3	88·2	85·4	83·9	83·2	82·5	82·0	81·0
91·2	91·4	91·8	91·3	90·8	88·2	85·6	84·0	83·4	83·3	83·0	82·8
91·0	91·4	91·0	90·0	89·6	87·4	85·2	83·6	83·2	83·0	83·0	82·8
90·8	90·5	90·8	90·0	89·3	87·2	84·8	83·3	82·7	83·4	82·3	82·2
91·5	92·0	92·0	92·2	87·8	89·6	87·0	85·2	84·4	83·8	83·5	83·2
92·3	91·8	92·4	91·0	90·8	89·0	86·7	85·0	84·3	83·7	83·2	83·2
91·0	91·6	91·4	91·2	90·5	88·5	85·8	84·4	83·8	83·5	83·2	83·0
92·2	92·8	93·0	92·5	92·0	90·0	87·4	85·6	85·0	84·4	84·0	83·8
92·0	92·3	92·5	92·2	90·8	89·2	86·8	85·0	84·4	84·0	83·6	83·4
93·2	93·2	93·0	93·0	92·2	89·8	87·4	85·6	84·8	84·2	83·6	83·4
93·0	93·0	93·2	94·0	92·0	90·5	87·6	85·4	84·6	84·2	84·0	84·4
93·2	93·0	94·2	93·5	92·2	89·8	87·3	85·4	84·6	83·8	83·5	83·4
92·5	93·2	93·0	93·2	92·0	90·5	87·6	85·8	85·0	84·5	84·4	83·8
93·0	93·4	93·4	93·0	91·5	90·0	87·4	85·5	84·8	84·3	83·9	83·6
92·3	93·4	93·5	93·0	92·0	89·8	87·4	85·4	84·5	84·0	83·4	83·0

June. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	82·3	82·2	82·0	81·8	81·6	81·4	82·1	85·6	87·8	90·0	91·3	92·2
2	84·5	84·0	83·8	83·4	83·2	83·2	83·8	86·0	89·3	91·5	92·8	93·8
3												
4	84·8	84·5	84·2	84·0	84·0	83·8	84·7	87·2	89·4	90·0	91·4	91·8
5	85·0	84·8	84·6	84·3	84·2	83·8	84·2	87·0	89·5	90·0	91·4	92·0
6	84·9	84·5	84·4	84·2	84·3	84·0	84·6	84·3	87·2	88·4	88·8	91·0
7	84·6	84·4	84·0	83·8	83·6	83·8	84·0	86·4	87·7	89·4	91·4	92·0
8	84·6	84·4	84·3	84·0	83·6	84·0	84·2	87·3	89·2	91·2	91·8	92·7
9	84·8	84·5	84·4	84·3	83·4	83·5	83·7	84·0	87·5	89·9	91·4	92·3
10												
11	84·7	84·4	84·5	79·4	80·5	80·7	81·6	82·5	84·4	86·0	90·2	92·8
12	84·6	84·0	83·4	83·3	83·2	83·0	83·7	84·8	87·2	89·6	91·4	91·5
13	82·6	82·6	82·8	82·4	83·3	82·6	83·4	85·0	82·5	81·5	81·0	80·8
14	81·2	80·6	79·9	79·4	79·5	80·0	80·4	81·4	78·5	80·8	79·5	82·2
15	79·6	79·5	80·2	80·0	79·7	80·0	80·6	85·7	84·6	86·0	87·2	88·1
16	81·2	80·6	80·3	80·3	79·4	80·5	79·0	78·2	81·3	82·9	85·4	87·4
17												
18	82·6	82·5	82·8	82·6	82·5	82·2	83·3	83·8	84·5	86·3	86·2	84·5
19	81·6	80·8	79·5	79·4	79·4	79·2	79·2	82·0	83·6	85·0	86·7	88·4
20	78·2	78·4	78·4	79·3	79·6	80·0	80·2	80·7	81·0	81·0	78·9	77·0
21	77·2	77·2	77·3	77·2	78·4	78·0	78·0	78·4	80·0	82·4	84·2	85·4
22	80·6	80·0	79·5	79·4	76·6	76·7	77·7	78·8	80·6	84·4	82·2	82·0
23	78·8	78·5	79·0	80·0	79·4	78·5	79·6	80·2	80·5	81·6	82·4	84·2
24												
25	82·4	81·6	81·6	81·0	80·5	80·2	80·0	80·8	82·2	84·2	84·7	86·0
26	81·8	81·5	80·6	80·5	80·4	80·4	81·0	82·7	83·0	84·2	85·4	85·8
27	78·4	77·5	78·8	78·8	79·0	79·2	79·0	79·0	80·0	81·0	81·5	83·0
28	78·4	78·2	79·4	80·0	80·5	81·4	81·5	82·4	83·4	84·6	86·6	87·4
29	78·8	77·2	77·4	79·0	79·4	79·0	79·5	79·0	78·6	77·6	77·5	78·2
30	81·4	81·3	81·2	81·2	79·6	79·2	81·2	82·3	80·5	81·1	82·8	83·8

June. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
92·5	93·4	93·8	93·2	93·0	91·0	88·3	86·5	85·5	85·0	84·8	84·6
94·8	95·3	95·2	95·0	94·0	92·7	89·3	87·2	86·2	85·5	85·2	85·2
92·6	93·5	94·2	93·4	92·8	91·0	89·4	87·0	86·4	86·0	85·0	85·3
92·9	93·3	93·3	92·6	91·6	90·0	87·8	86·2	85·6	85·4	85·0	85·0
91·6	91·8	92·2	91·8	90·6	89·5	87·3	85·7	85·4	85·0	84·6	84·4
92·4	92·5	92·4	92·4	91·4	89·0	87·3	85·7	85·4	85·4	84·2	84·8
92·3	92·4	92·0	92·2	91·3	90·0	87·0	85·8	85·2	85·0	84·8	84·8
92·3	92·0	92·6	92·4	92·5	89·0	86·6	86·4	86·0	85·4	85·2	85·4
92·6	94·5	94·5	94·0	93·3	91·4	88·7	87·0	86·4	86·2	85·6	85·2
91·2	91·8	91·4	91·0	89·2	81·6	80·3	81·0	81·2	81·8	81·2	81·8
82·4	83·4	84·0	81·4	79·4	80·4	80·5	80·4	80·0	80·4	80·6	80·8
82·2	83·4	85·4	83·4	81·3	80·2	79·4	78·4	78·4	79·0	79·2	79·6
89·5	82·4	83·0	81·0	81·7	81·4	81·2	80·4	80·0	80·0	80·8	80·8
88·0	88·3	88·4	89·4	87·4	87·8	85·5	84·2	83·5	83·3	83·0	82·3
81·6	84·2	85·3	87·5	87·8	87·0	85·2	83·7	83·4	83·2	83·0	82·4
87·7	88·3	84·2	84·4	83·7	79·7	79·3	77·2	76·4	77·8	78·2	78·6
76·6	77·4	79·4	80·5	80·3	80·2	80·2	77·4	76·0	76·0	76·2	76·5
84·3	84·4	85·2	83·0	81·3	81·4	81·3	80·0	79·7	80·3	80·3	79·8
84·2	81·4	81·0	81·0	80·4	81·0	81·0	80·2	80·0	79·9	79·6	79·0
87·0	84·0	87·4	86·3	86·8	86·8	84·3	83·0	82·4	82·2	82·0	81·4
88·1	87·8	86·3	86·0	86·2	86·4	84·4	83·6	82·8	82·8	82·6	82·2
88·4	88·8	86·0	82·6	83·2	84·7	83·2	81·0	77·0	77·4	78·4	78·0
84·5	81·0	81·3	80·0	79·0	78·4	78·4	79·0	79·4	78·4	79·0	78·6
88·5	88·8	85·2	85·0	84·6	84·0	82·8	81·7	80·4	80·0	80·2	79·4
77·7	78·2	77·4	78·8	80·3	76·5	77·4	78·5	79·2	80·2	81·2	81·0
83·0	83·8	83·0	82·3	83·2	82·3	81·4	81·3	80·5	80·2	80·6	80·8

9*

July. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1												
2	80·7	80·9	81·2	80·0	80·6	78·0	77·3	78·6	79·4	77·4	77·0	79·4
3	81·0	80·6	80·6	80·2	80·8	78·6	78·2	78·5	79·8	79·0	83·2	81·0
4	80·4	79·6	81·0	81·0	80·8	81·0	77·0	75·8	77·0	77·5	77·6	77·8
5	77·5	78·6	79·8	80·1	80·2	80·2	80·4	79·8	78·4	78·2	77·4	79·0
6	80·4	80·4	80·4	80·4	80·0	78·4	79·8	81·0	83·4	85·0	86·4	87·8
7	80·4	80·4	80·7	80·8	80·4	80·0	80·4	81·4	83·4	85·8	86·0	85·4
8												
9	80·6	80·4	80·4	80·6	80·2	80·3	80·5	80·6	83·2	85·0	85·6	87·0
10	81·4	81·2	81·3	81·2	81·2	81·3	81·3	81·8	82·2	83·4	84·0	83·8
11	81 4	81·4	81·3	81·2	81·2	81·3	81·3	83·2	82·8	83·8	82·0	83·8
12	81·2	81·4	81·2	81·2	81·1	81·2	80·4	79·8	82·2	84·0	82·8	84·0
13	81·2	80·8	80·4	80·4	80·6	80·5	79·2	80·3	79·8	79·0	83·8	84·4
14	79·0	78·8	80·4	80·4	80·8	80·0	79·7	81·8	81·3	81·8	85·3	86·0
15												
16	79·5	80·0	81·1	79·8	80·2	80·4	80·3	81·4	83·2	85·4	86·5	87·6
17	80·4	80·8	80·6	80·6	80·4	80·3	80·4	81·3	83·2	83·2	85·4	86·2
18	80·5	80·7	79·0	78·2	79·8	80·0	79·4	80·6	81·3	83·2	84·4	85·4
19	80·4	80·8	81·0	80·8	80·2	79·0	80·2	80·8	82·2	83·2	85·8	85·2
20	79·2	79·0	79·0	80·4	80·4	80·3	79·8	80·4	81·4	82·6	84·2	84·4
21	80·4	80·4	80·4	80·4	80·6	80·5	80·8	81·7	83·0	84·2	85·2	86·4
22												
23	81·2	81·0	81·0	80·9	80·8	79·2	79·6	80·4	82·0	85·2	86·0	85·8
24	81·0	81·1	81·8	80·4	79·6	79·3	80·2	80·5	82·0	81·4	85·6	86·6
25	80·0	80·0	79·8	79·8	71·8	76·3	78·8	80·5	81·2	83·8	85·6	86·4
26	79·8	80·3	80·2	79·4	78·4	79·4	80·0	80·4	83·0	85·0	86·2	87·0
27	80·7	80·0	80·2	78·8	79·4	79·8	80·0	80·4	82·6	84·2	85·3	86·8
28	80·2	79·4	79·8	79·0	79·2	79·0	79·3	81·2	82·2	84·2	86·0	85·7
29												
30	80·3	78·2	79·2	79·3	79·0	79·0	78·8	79·2	80·3	82·9	85·5	84 5
31	79·3	79·4	79·0	79·4	80·0	80·1	79·6	82·0	82·1	84·3	86·3	87·4

July. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
81·0	80·2	79·6	78·7	80·7	80·3	80·6	80·8	80·8	80·0	80·4	80·4
82·2	80·8	81·9	80·6	81·3	78·8	79·5	78·3	78·0	77·4	78·6	79·4
78·5	78·4	79·3	79·4	78·4	78·4	78·3	77·3	77·0	77·0	77·4	77·6
82·2	83·6	83·3	83·1	83·1	82·4	81·8	81·3	81·0	80·8	80·7	80·6
88·2	88·5	86·4	86·1	84·6	82·0	81·6	81·2	81·5	80·2	80·4	80·5
88·0	89·4	87·8	85·3	78·4	79·8	79·3	80·2	80·0	80·2	80·6	80·0
87·2	86·9	87·1	85·6	85·8	84·0	83·0	82·4	81·4	81·6	81·6	81·4
84·0	84·1	84·8	85·0	84·0	83·0	82·5	82·0	81·5	81·4	81·4	81·3
84·7	85·2	86·0	86·8	86·2	84·7	83·2	82·8	82·3	82·0	81·4	81·4
84·4	84·4	83·8	84·3	82·8	82·8	82·2	82·0	82·0	81·4	81·5	81·2
83·4	85·4	84·0	81·3	83·4	82·8	82·3	82·0	81·8	81·5	81·2	81·0
86·4	87·2	86·5	86·5	84·8	84·4	83·0	79·4	80·4	80·6	80·5	81·2
88·0	88·2	88·8	89·3	88·8	84·5	82·6	81·7	81·3	81·2	80·4	80·7
86·5	86·0	84·1	83·8	82·4	82·0	81·0	81·0	80·2		81·8	81·0
84·2	85·0	85·2	83·1	83·4	83·0	82·0	81·6	81·3	81·0	81·0	80·2
87·8	88·0	82·7	83·0	79·6	80·0	79·3	80·3	78·3	79·8	79·4	80·0
84·0	85·8	86·9	86·2	83·4	84·0	82·4	81·5	81·0	80·8	80·4	80·4
87·5	87·0	87·0	87·4	86·9	84·9	83·0	81·8	81·5	81·2	81 2	81·0
86·8	88·0	87·0	87·4	85·2	84·0	82·5	82·0	81·5	81·2	81·4	80·8
87·0	87·0	85·2	85·2	84·2	84·3	82·3	81·5	81·4	80·8	80·5	81·0
86·7	85·5	85·5	86·5	85·7	83·2	82·4	82·0	81·4	81·4	81·2	82·2
88·2	87·8	87·4	86·7	85·8	84·0	81·7	81·3	81·0	80·8	80·8	80·5
86·2	87·8	87·3	85·2	83·8	82·2	82·5	81·0	80·4	80·4	80·4	80·3
88·2	87·5	85·8	86·8	86·0	85·8	83·4	82·2	81·4	80·0	80·4	79·0
86·0	86·4	86·8	86·2	85·0	84·7	82·2	81·4	81·2	81·5	80·4	79·2
87·7	87·2	86·8	84·2	86·0	84·8	83·3	82·0	81·6	81·3	80·5	80·4

August. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	78·2	79·0	79·2	79·4	80·0	78·8	79·5	80·6	82·5	83·4	85·2	87·3
2	81·0	80·8	80·2	78·2	79·0	78·8	79·0	80·6	81·6	82·2	85·5	85·5
3	79·2	80·0	80·0	80·0	79·4	78·0	78·0	79·3	82·0	82·3	83·6	85·8
4	80·5	80·2	80·2	79·0	78·5	79·6	80·0	81·2	81·0	84·0	83·8	84·5
5												
6	80·3	80·4	80·4	80·3	80·4	80·5	80·5	80·9	82·2	82·4	83·2	86·5
7	80·8	80·6	80·2	80·0	80·0	80·0	80·0	83·6	82·8	81·2	84·4	86·2
8	80·2	80·0	80·0	80·0	80·0	80·2	80·2	80·6	81·8	84·2	86·9	87·8
9	80·4	80·4	80·0	80·0	79·6	79·5	79·8	80·7	82·9	80·6	83·9	84·8
10	80·2	80·0	79·8	79·4	79·4	79·2	79·2	84·2	83·9	85·3	85·7	87·2
11	80·2	79·8	79·7	79·4	79·2	79·2	79·0	79·5	83·6	85·8	85·2	86·9
12												
13	80·5	79·2	78·5	78·2	77·0	77·4	78·4	79·0	80·8	83·0	85·0	87·0
14	80·2	80·0	80·4	80·2	80·0	79·8	80·2	80·3	82·4	85·5	86·3	88·3
15	80·2	79·2	78·5	79·0	78·4	78·8	79·0	84·5	83·4	80·5	83·0	85·0
16	81·0	80·7	80·3	79·8	79·0	78·2	78·6	81·2	81·2	82·6	85·2	87·0
17	79·4	79·8	79·4	79·0	79·0	79·2	79·0	80·3	82·5	83·8	84·8	81·0
18	79·4	79·0	79·0	79·0	78·8	78·8	78·5	80·0	83·1	84·2	85·6	86·5
19												
20	79·8	79·5	79·4	78·7	78·0	78·0	79·0	79·6	81·4	83·8	85·5	79·3
21	80·0	78·2	79·4	79·0	78·4	79·2	79·2	80·6	81·1	82·6	85·4	87·3
22	80·4	80·4	80·2	80·0	80·0	80·2	80·0	81·4	83·0	83·6	84·6	80·6
23	79·8	79·4	79·2	79·0	79·0	79·0	79·0	79·5	81·0	81·3	85·6	86·4
24	79·5	79·2	78·5	78·6	78·4	77·6	77·5	77·1	81·2	83·4	84·4	85·8
25	79·6	79·2	79·2	79·0	78·8	78·8	78·0	77·3	79·7	81·2	82·6	84·0
26												
27												
28	80·3	79·8	79·4	79·0	79·0	78·6	78·5	79·6	81·6	84·0	86·3	86·3
29	80·4	80·2	80·2	80·0	79·5	79·6	79·4	80·5	80·8	84·6	86·0	84·4
30	80·2	80·0	79·5	79·5	79·4	78·4	78·6	79·4	81·2	82·4	85·3	86·4
31	79·6	79·5	79·6	79·0	76·4	76·8	75·8	76·0	75·6	75·0	76·0	75·3

August. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
87·8	88·2	87·8	84·4	84·5	85·0	83·0	82·0	81·4	81·3	81·2	81·1
86·6	86·2	87·2	86·0	83·2	84·0	82·0	79·8	79·2	79·9	80·0	80·0
86·3	86·0	84·2	82·6	83·2	82·3	81·6	80·0	80·0	80·6	80·4	80·2
86·0	85·2	85·0	84·2	84·0	82·5	81·8	81·4	80·8	80·8	80·6	80·7
86·5	86·3	85·0	86·4	86·0	84·5	82·8	82·0	81·6	81·5	81·3	80·8
88·4	87·0	87·8	86·7	85·2	84·8	83·2	81·8	81·2	81·3	81·0	80·5
87·5	88·2	87·2	87·8	86·8	83·9	82·8	82·0	81·5	80·4	80·5	80·4
87·4	88·2	88·0	87·0	85·7	83·9	82·8	81·8	81·4	81·2	80·6	80·5
85·0	88·2	85·7	86·4	87·5	84·5	82·8	81·7	81·2	81·0	81·5	80·0
88·2	88·5	89·2	85·2	85·8	86·3	84·0	82·2	81·3	81·0	80·3	80·3
87·4	86·8	87·0	87·8	88·2	85·1	83·2	82·0	81·4	81·0	81·0	81·4
88·8	88·8	89·0	87·3	85·4	83·8	80·0	80·4	79·4	80·2	80·2	80·3
85·4	87·0	87·5	87·6	87·3	85·5	83·2	82·2	81·6	81·2	80·0	80·0
87·5	88·4	88·6	88·5	88·0	85·2	82·8	81·2	81·6	81·0	80·5	80·2
83·6	86·4	87·4	87·4	86·4	85·1	82·7	81·1	80·5	80·2	80·2	79·4
87·2	87·4	88·3	87·7	86·3	84·6	82·9	81·6	81·0	80·5	80·2	80·0
83·5	84·3	86·4	85·4	84·2	83·4	81·9	81·4	80·6	80·6	80·4	79·8
87·4	88·2	88·8	89·0	87·0	85·5	83·2	82·4	82·0	81·0	80·6	80·4
84·4	84·3	86·0	83·8	82·4	80·5	81·1	80·7	79·8	80·2	80·2	80·2
87·3	88·0	88·2	88·4	86·2	85·8	83·2	81·5	81·0	80·5	80·3	79·8
86·3	87·3	88·2	87·2	85·6	83·8	82·5	81·2	81·0	80·5	80·0	80·3
86·2	86·8	87·2	87·2	86·4	85·0	82·5	81·0	80·3	77·0	77·0	77·4
86·6	83·2	85·2	87·4	87·5	85·8	83·0	81·4	81·2	81·0	81·0	80·7
86·8	88·7	89·2	89·0	89·0	84·6	82·1	82·1	81·4	81·2	80·4	80·4
87·5	86·5	86·2	85·4	82·2	82·3	81·7	81·0	80·0	80·2	80·5	79·8
76·0	75·4	75·2	74·4	74·8	74·8	74·6	74·8	75·3	75·0	75·3	75·3

September. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	75·5	76·0	75·2	75·4	76·0	75·6	75·6	77·3	78·5	82·4	84·3	85·0
2												
3	78·6	79·0	78·2	78·3	78·8	78·0	78·4	79·4	82·0	80·8	83·2	86·4
4	78·8	79·0	78·5	78·5	78·5	78·4	78·0	78·4	79·0	79·7	81·0	85·4
5	79·4	79·2	79·4	79·4	79·5	79·4	80·0	80·0	80·5	81·8	83·3	84·6
6	79·6	79·4	78·4	79·0	78·3	77·2	77·4	79·4	81·4	83·1	84·4	85·4
7	79·2	79·5	79·2	78·8	79·0	78·2	78·6	79·0	80·0	82·6	83·0	86·0
8	79·6	79·3	79·3	79·3	79·5	78·0	79·0	79·7	83·0	84·0	85·5	84·5
9												
10	77·0	79·0	79·0	79·4	77·8	77·4	78·5	78·2	79·0	80·7	79·6	78·2
11	78·8	77·2	78·0	78·0	77·3	76·4	76·2	77·4	79·2	81·0	81·8	80·2
12	78·0	77·3	78·5	78·3	78·3	78·0	77·6	79·6	80·5	82·6	84·0	85·0
13	79·4	79·3	79·0	79·0	78·7	78·4	78·7	79·6	83·0	84·4	85·0	86·4
14	78·8	79·3	79·2	76·2	77·4	77·2	78·0	79·4	81·0	82·3	81·2	84·7
15	79·3	79·4	79·2	79·2	79·2	79·0	78·7	78·2	79·8	80·9	81·4	80·6
16												
17	77·8	78·8	79·3	79·0	79·2	79·0	77·4	79·8	81·0	82·6	85·4	85·0
18	79·2	79·4	79·4	79·3	78·0	77·6	77·0	75·4	76·2	77·0	77·8	80·8
19	78·4	78·0	78·4	78·8	78·4	78·2	78·0	79·4	82·0	83·7	84·6	84·2
20	78·6	78·8	78·3	78·0	78·3	78·0	77·6	78·6	82·5	83·7	84·5	84·5
21	78·0	77·5	77·5	77·7	78·3	77·0	76·0	76·5	75·0	75·6	77·2	79·6
22	77·0	77·0	76·4	77·0	77·5	76·6	77·0	78·0	80·5	81·6	82·4	83·4
23												
24	80·8	80·5	80·4	80·0	79·0	78·2	78·2	80·2	83·0	84·2	85·1	87·0
25	77·0	79·0	79·2	79·2	78·6	78·2	78·2	80·6	83·0	82·7	81·7	85·2
26	79·0	78·0	77·2	76·8	76·6	77·0	77·2	80·6	82·4	81·6	84·3	85·2
27	79·6	79·4	79·0	79·0	79·0	79·2	79·0	81·0	83·6	85·4	85·6	86·7
28	77·8	77·6	77·2	77·4	77·4	77·5	77·7	78·4	81·0	80·8	81·4	80·7
29	77·0	77·0	76·6	77·0	77·0	77·0	77·0	78·4	80·0	81·0	82·0	82·4
30												

September. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
85·9	86·3	86·8	87·0	87·0	85·2	82·0	80·5	80·2	79·6	79·0	79·4
84·1	86·6	85·3	86·4	80·5	82·4	80·8	80·0	79·4	79·0	79·0	79·0
85·6	85·3	84·4	84·7	83·0	80·7	81·2	81·0	80·0	79·0	78·8	78·6
86·8	87·2	86·4	86·0	85·4	83·8	80·4	80·0	80·0	79·4	79·6	79·4
86·6	86·0	87·0	86·4	83·6	83·2	81·0	80·2	79·4	79·6	79·0	79·6
85·4	83·3	85·3	85·0	82·2	81·4	80·3	80·0	80·2	78·8	78·8	79·4
83·5	82·0	82·0	82·2	82·3	81·8	81·0	80·4	80·2	80·2	80·0	80·0
80·2	79·6	82·2	79·0	80·2	80·0	77·6	77·2	77·2	78·0	78·0	78·9
83·2	81·6	81·0	81·2	78·3	79·4	79·0	79·0	77·0	76·2	76·2	77·6
86·0	86·3	87·0	85·0	82·8	81·4	80·5	80·2	80·2	79·0	79·8	79·2
86·7	87·3	87·5	86·3	84·6	83·2	81·4	81·0	79·2	84·8	80·0	79·2
86·0	86·0	86·7	87·0	84·2	83·0	81·7	80·4	80·0	80·4	79·4	79·4
85·2	85·4	84·0	86·2	85·4	83·2	81·7	80·4	80·2	79·0	78·7	78·0
86·4	87·3	86·3	85·2	85·7	83·4	81·8	80·4	79·4	79·2	79·2	79·4
81·0	83·0	84·8	85·0	83·0	81·4	80·2	79·3	79·0	78·8	78·6	79·2
84·0	85·3	85·4	85·4	85·4	83·5	81·0	80·0	79·2	79·0	78·8	78·6
86·4	87·2	87·6	87·0	86·6	84·2	81·6	80·4	80·0	79·4	79·0	78·8
81·2	84·2	85·4	86·2	85·5	83·6	80·7	79·7	79·0	78·8	78·7	77·2
85·2	86·2	86·2	85·2	85·0	84·0	82·0	81·3	81·2	81·0	80·8	80·0
88·0	88·3	88·0	87·4	85·4	83·2	82·0	81·2	80·8	80·3	79·0	79·3
84·4	85·2	86·6	86·6	86·2	84·0	81·4	80·4	79·7	79·6	79·2	79·0
86·0	86·4	87·0	86·6	86·2	84·8	82·2	81·2	81·0	80·5	80·3	80·0
87·2	87·8	88·0	87·8	87·0	85·2	83·4	78·2	77·4	78·0	77·2	77·3
83·2	85·0	86·6	87·0	87·0	85·3	83·0	80·4	78·5	77·4	77·2	77·0
85·4	85·5	85·8	88·0	87·0	86·2	83·7	82·6	81·2	80·4	79·8	79·0

October. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	77·2	77·4	78·1	77·6	77·9	78·0	77·8	78·6	81·4	83·0	84·4	85·4
2	81·0	80·8	81·0	80·7	79·8	79·8	79·6	82·5	83·2	84·4	86·0	86·8
3	81·2	80·8	80·6	79·7	79·6	79·2	79·6	82·0	84·0	85·6	86·4	86·5
4	81·2	81·2	81·0	80·4	80·0	80·2	80·3	81·6	84·2	85·0	86·5	87·6
5	81·7	81·4	81·2	80·4	80·2	80·0	79·4	82·0	84·4	86·0	86·0	87·0
6	80·2	80·0	79·6	79·3	78·4	78·2	78·2	80·0	83·0	85·0	86·8	87·4
7												
8	78·6	79·3	79·9	78·6	79·5	79·2	78·6	78·7	80·8	82·8	84·0	84·8
9	80·4	80·0	79·6	78·8	77·8	77·8	76·5	79·5	83·0	84·4	85·4	88·0
10	80·7	79·5	78·8	78·2	79·0	79·0	79·0	81·1	82·9	84·2	85·2	87·2
11	80·5	80·2	79·6	78·2	78·8	77·8	76·2	79·4	84·0	86·0	87·2	90·0
12	80·0	80·2	80·0	80·0	79·9	79·5	79·8	80·0	81·2	83·8	86·0	86·0
13	78·4	78·8	78·6	78·1	78·2	78·2	78·2	80·2	82·0	83·4	85·4	86·2
14												
15	79·0	79·0	78·7	78·6	78·2	78·0	78·0	79·2	82·4	84·2	86·0	87·2
16	80·0	80·0	80·2	79·8	79·6	79·2	79·0	81·0	83·2	83·8	85·4	86·0
17	81·0	81·0	80·8	80·8	80·0	79·4	79·0	81·6	83·0	84·5	85·2	86·8
18	79·5	79·2	78·6	78·0	78·0	78·2	78·6	80·0	81·5	83·6	86·0	86·8
19	81·0	80·4	79·6	79·4	79·0	78·9	79·4	79·2	80·0	82·0	84·5	85·8
20	81·0	81·0	81·0	80·8	80·4	80·0	79·6	81·4	83·0	84·0	85·2	85·5
21												
22	79·7	80·4	80·8	80·8	80·2	80·4	80·2	82·0	83·6	87·0	88·4	89·0
23	80·0	80·2	79·8	79·2	79·0	78·8	79·2	80·6	82·5	84·7	86·0	88·0
24	79·4	79·2	78·6	78·2	78·0	77·8	77·2	79·0	82·4	83·4	86·0	87·0
25	79·0	78·8	78·6	78·2	78·0	77·8	77·4	78·8	80·2	82·8	84·6	85·6
26	79·0	78·7	78·6	78·0	78·2	77·3	77·6	78·5	79·6	81·2	82·5	83·2
27	78·2	78·2	78·4	78·4	79·0	78·8	79·0	79·2	80·4	84·0	83·8	85·0
28												
29	77·2	77·0	76·8	76·4	78·0	76·0	77·2	79·0	81·2	82·7	83·5	84·2
30	77·0	77·0	76·6	75·8	75·2	74·5	74·4	75·6	78·7	82·0	84·0	86·0
31	75·4	75·2	74·8	74·7	73·8	73·0	74·2	75·6	79·3	82·0	84·0	85·3

October. P. M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
86·2	87·4	88·0	87·7	87·8	85·6	83·6	82·2	81·8	81·2	81·2	81·2
87·2	88·2	88·6	88·9	88·6	86·4	83·4	82·9	82·2	81·6	81·4	81·2
87·5	88·3	89·0	89·4	89·0	86·6	84·2	83·2	83·3	82·2	81·4	81·2
88·2	89·2	89·8	89·8	89·2	86·8	84·2	83·4	83·0	82·5	82·4	82·2
87·5	88·7	89·6	89·4	88·2	85·6	83·8	83·0	82·3	81·8	81·4	81·0
88·4	89·0	89·5	89·6	89·4	87·0	84·2	83·0	82·4	81·8	81·2	81·0
86·8	90·0	89·8	89·0	88·7	86·8	83·4	83·0	82·0	80·7	80·6	80·7
89·0	89·9	90·0	89·4	88·8	86·8	83·9	83·0	82·8	82·0	81·2	81·0
90·4	91·7	92·5	90·6	88·2	81·0	83·5	82·9	82·4	82·4	81·7	81·4
90·2	90·3	91·0	85·5	85·7	83·4	83·0	81·0	80·0	80·2	80·2	80·0
87·8	89·6	90·2	84·4	80·8	80·6	80·0	79·9	79·5	79·0	79·0	79·0
87·5	88·0	88·0	90·5	89·8	88·0	84·8	83·4	82·8	82·2	81·0	80·3
87·8	88·2	88·6	88·4	86·4	82·8	82·0	82·0	81·0	80·7	80·2	80·0
87·0	88·1	88·8	89·0	88·0	85·4	83·0	82·2	82·0	81·5	81·2	81·0
87·2	88·4	88·4	87·6	87·4	85·3	83·4	82·4	82·0	81·8	81·0	80·4
87·5	88·0	88·6	88·5	87·6	86·0	84·8	83·4	83·0	82·4	82·0	81·0
87·2	88·4	88·8	88·4	88·0	87·0	84·5	83·8	83·6	83·2	82·5	81·7
88·2	89·5	90·4	89·2	88·0	86·4	84·8	84·4	84·0	83·6	82·2	82·8
91·0	87·4	84·8	83·8	80·8	80·4	79·7	79·7	79·6	79·6	79·6	79·8
89·0	88·8	88·4	87·0	85·5	83·2	82·0	81·2	80·4	80·2	80·0	80·0
87·3	87·7	86·6	85·3	83·0	82·0	81·4	81·2	81·2	80·4	80·0	79·4
86·4	87·0	87·5	88·0	87·8	84·0	81·6	80·5	80·0	78·7	78·4	78·4
84·5	85·4	87·2	87·5	87·0	85·0	81·8	80·0	80·2	79·5	79·0	78·7
85·4	86·4	86·2	87·2	86·0	83·7	82·0	81·5	81·4	79·7	79·0	79·3
85·4	87·0	86·8	87·4	86·0	83·6	81·4	80·6	80·2	79·4	77·4	77·0
87·0	87·6	87·6	87·5	87·0	84·7	82·4	81·5	79·6	78·4	77·0	76·5
86·2	87·2	88·0	88·0	87·5	85·1	82·8	81·9	81·4	79·4	77·6	78·4

November. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	76·4	75·5	75·8	77·2	75·8	75·8	75·4	76·9	79·8	81·2	82·7	83·8
2	76·0	76·4	71·8	75·4	74·8	74·0	71·6	75·1	77·0	78·4	81·2	82·2
3	75·8	75·0	74·6	75·4	74·2	73·4	72·9	75·4	77·2	79·4	81·7	83·2
4												
5	77·4	78·2	76·0	75·0	75·0	74·6	73·6	75·5	77·4	79·7	83·0	85·0
6	75·8	75·0	78·0	76·0	75·5	76·0	76·6	77·2	78·8	80·9	83·0	86·5
7	79·2	78·4	78·0	78·2	77·4	78·0	78·2	79·6	82·4	84·7	85·3	86·9
8	80·2	80·4	80·0	79·2	79·0	78·6	82·8	81·0	83·4	85·2	85·4	87·0
9	81·4	80·0	80·0	80·4	80·4	80·5	80·2	81·4	83·4	85·0	85·2	87·8
10												
11												
12	79·6	79·0	79·0	78·5	78·2	77·0	77·3	78·0	81·2	83·8	84·9	86·6
13	78·1	77·6	78·0	78·0	77·0	76·6	76·4	78·2	80·8	82·0	84·5	86·1
14	76·4	76·0	76·2	76·2	77·0	76·0	77·1	78·5	80·2	81·4	82·8	84·1
15	76·8	77·0	78·6	77·0	76·5	76·4	76·2	77·2	78·4	80·3	82·7	83·8
16	77·2	77·0	77·2	76·4	76·4	75·1	75·6	75·6	79·2	81·2	82·4	85·7
17	77·2	77·0	76·0	74·4	73·4	73·2	72·8	75·2	78·6	81·2	82·7	83·7
18												
19	76·8	74·8	74·0	75·0	75·4	75·2	73·2	75·2	78·0	80·0	81·5	83·3
20	75·7	74·0	72·8	72·2	74·0	75·4	75·0	75·0	78·2	80·4	81·2	82·8
21	77·6	76·2	75·0	74·0	75·4	75·0	74·6	76·8	78·4	80·1	81·7	84·4
22	78·0	76·7	77·5	77·4	76·2	75·6	75·4	75·4	78·0	80·0	82·4	84·5
23	78·2	76·0	75·3	75·4	75·0	74·6	74·3	75·0	77·8	79·4	81·6	83·2
24	75·8	75·0	75·2	75·0	73·2	73·8	73·2	74·4	77·0	79·3	80·5	81·8
25	76·8	76·2	76·4	75·6	75·6	74·0	73·8	74·8	77·0	78·6	80·1	81·2
26												
27	76·2	76·0	76·4	75·8	75·0	74·6	74·8	75·0	75·8	77·4	79·9	82·1
28	74·9	74·5	75·0	75·4	74·0	73·4	72·2	72·0	77·0	79·7	80·2	81·8
29	74·2	73·2	73·0	73·4	75·0	73·0	72·8	74·8	78·5	78·1	80·3	82·4
30	73·0	72·4	72·2	72·0	73·0	73·0	72·3	72·4	76·0	78·2	79·9	81·8

November. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
86·2	88·2	89·6	89·9	88·4	85·9	83·6	82·6	82·0	80·2	79·0	77·0
85·2	87·2	88·5	88·7	87·1	84·6	82·8	82·0	80·6	77·6	76·2	76·0
86·4	89·1	88·6	89·0	88·0	85·4	82·8	81·6	81·0	79·6	77·0	75·4
87·5	89·4	90·2	91·0	91·4	87·2	83·8	82·6	81·6	80·8	77·6	77·0
88·4	90·4	90·4	91·0	90·0	86·8	84·4	82·6	82·4	81·8	81·4	79·6
87·6	88·8	90·4	90·2	90·2	87·5	84·5	83·4	81·8	89·6	81·2	80·8
88·3	90·8	90·2	90·0	89·0	87·5	85·0	84·2	83·2	83·6	82·8	82·2
89·7	90·0	90·0	90·2	89·7	87·6	85·0	84·0	83·0	81·8	81·2	80·3
89·2	90·4	91·5	90·4	87·0	85·0	83·0	82·6	81·8	80·4	78·8	78·7
87·2	88·2	89·0	89·0	87·7	84·3	82·2	81·2	80·6	79·6	78·2	77·4
88·0	86·8	87·4	86·3	83·4	81·4	80·5	79·4	78·8	77·4	76·8	76·5
85·9	87·8	88·8	88·8	88·0	84·8	82·6	81·8	81·2	79·4	78·8	77·5
80·2	86·0	86·3	87·0	84·0	82·7	81·9	81·2	81·2	80·2	78·2	76·6
84·4	86·5	87·4	87·4	86·6	83·6	81·8	81·2	81·0	78·8	77·4	77·4
86·8	87·2	87·2	87·0	86·2	83·4	81·7	80·8	80·6	79·2	77·4	76·0
85·2	87·4	87·3	87·5	86·4	83·4	81·7	81·0	80·4	79·0	77·1	77·4
87·1	88·5	89·1	89·4	88·0	84·2	82·6	81·8	81·2	80·0	77·8	78·6
85·3	87·0	88·2	88·5	87·4	83·8	81·7	81·0	80·0	78·6	77·0	76·4
84·2	86·7	87·2	87·5	86·2	82·8	80·8	80·0	78·4	77·6	76·0	75·4
84·2	85·7	87·3	87·5	87·0	83·3	81·0	80·0	79·0	77·4	76·8	76·2
83·6	85·0	86·2	87·0	86·0	82·0	80·1	78·2	76·8	76·4	75·8	76·8
84·5	87·0	87·0	84·6	84·0	82·2	80·8	80·4	79·6	77·8	76·2	75·8
84·4	85·0	86·2	86·1	85·6	82·4	80·6	79·8	78·8	76·8	75·2	74·2
84·8	85·2	85·8	85·8	85·2	81·8	80·4	80·0	79·2	76·8	74·2	74·6
84·0	85·4	86·3	87·0	86·4	82·6	80·4	80·0	79·2	78·6	77·4	74·8

December. A.M.

(Bombay.)

Day of the month.	Mdn.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	74·4	74·0	74·0	73·2	73·4	72·6	72·4	72·8	76·2	77·8	80·8	82·7
2												
3	74·6	74·2	73·5	73·4	73·2	73·0	78·7	73·6	76·0	77·8	79·5	81·8
4	75·8	75·1	75·2	74·6	74·0	74·0	74·3	74·4	76·4	78·6	80·4	82·6
5	75·2	76·2	75·6	75·5	75·2	75·0	75·2	75·4	78·2	80·2	81·8	84·0
6	77·8	77·0	77·0	77·1	76·2	74·8	75·0	76·0	78·4	80·2	83·4	85·2
7	77·2	77·4	77·8	77·7	78·0	77·4	77·0	78·2	80·2	82·4	83·8	84·4
8	76·8	76·2	76·1	75·9	76·8	76·0	75·2	76·0	78·8	79·8	79·6	83·0
9												
10	77·5	77·7	77·8	77·2	78·8	76·4	75·7	77·4	80·0	81·4	83·6	84·8
11	78·0	78·0	77·4	77·0	76·8	76·2	76·0	75·0	79·0	80·4	81·6	83·8
12	77·0	78·7	78·2	76·0	75·9	76·0	76·0	75·8	77·4	79·8	81·4	82·4
13	75·8	77·2	75·8	75·2	74·7	75·0	74·2	74·8	77·0	79·4	81·0	81·8
14	74·2	74·6	74·4	73·6	73·1	72·0	73·4	74·5	76·3	78·3	79·7	86·2
15	73·4	73·4	71·8	74·6	75·0	72·8	72·2	72·7	75·8	77·8	78·8	81·5
16												
17	70·2	69·8	70·2	68·7	68·6			70·0	72·0	73·8	75·4	77·5
18	71·4	77·9	71·8	71·8	71·4	71·0	70·4	70·4	72·6	75·2	77·6	79·7
19	71·8	71·7	71·8	69·7	70·7	70·6	70·4	71·0	72·7	75·2	77·2	79·4
20	72·4	71·1	70·6	71·4	71·6	71·8	70·2	71·3	73·0	75·6	77·5	78·8
21	70·6	70·6	70·1	70·8	67·4	69·0	68·5	68·4	71·8	74·2	78·2	82·3
22	71·4	70·4	71·2	69·2	68·3	68·0	68·2	69·0	71·7	73·5	76·0	80·2
23												
24	71·4	72·1	71·6	71·5	70·5	70·0	70·0	69·0	71·4	73·2	75·8	78·4
25												
26	74·0	73·2	72·9	73·2	73·3	72·8	72·3	71·7	75·0	76·2	78·2	80·6
27	73·4	72·4	71·8	71·4	71·4	69·6	70·0	71·8	73·6	76·0	78·2	80·6
28	71·6	72·2	70·2	69·0	69·2	69·0	68·5	68·7	71·5	75·0	77·8	79·8
29	70·2	70·1	69·5	67·8	67·8	67·0	66·7	66·2	70·0	73·4	76·0	79·7
30												
31	71·0	71·2	72·6	72·8	72·0	71·6	71·5	72·4	74·3	76·5	78·5	80·1

December. P.M.

(Hourly readings, day by day.)

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
84·0	85·5	86·2	86·8	86·6	82·8	81·5	80·2	79·0	77·0	75·2	76·0
85·2	87·1	88·4	86·7	86·2	82·6	80·0	79·4	78·4	77·2	75·2	76·2
84·4	88·1	88·4	87·8	88·2	82·7	80·2	79·5	79·4	78·8	78·0	76·8
85·1	86·9	88·1	89·1	90·8	85·2	82·0	80·7	80·2	80·0	79·2	78·4
85·4	86·0	87·2	87·2	86·1	83·0	80·5	80·0	79·6	79·4	78·0	77·8
85·8	86·2	85·4	84·9	82·8	81·3	80·0	79·4	79·0	78·5	78·2	78·0
84·8	85·1	84·4	84·5	82·9	81·2	80·2	79·3	79·2	79·2	79·0	78·2
86·2	87·0	87·4	87·4	87·1	84·0	82·0	81·0	80·6	79·8	79·2	78·4
84·8	85·6	88·6	85·9	83·4	81·7	80·5	80·0	79·7	79·0	77·8	77·2
83·6	84·8	85·9	86·0	84·8	82·0	80·0	79·4	79·0	78·6	77·0	78·6
83·2	83·9	84·6	85·4	85·0	82·2	80·2	79·4	79·0	77·3	76·0	75·4
82·5	83·8	84·8	85·2	85·0	81·7	79·8	79·0	78·0	71·6	74·5	74·0
82·1	83·6	84·5	84·6	83·8	80·9	78·9	78·6	77·1	75·6	74·2	73·4
81·2	84·0	84·0	84·2	83·7	80·7	78·4	77·2	77·0	75·5	73·8	72·5
82·6	85·6	85·4	85·0	84·3	80·0	79·2	78·2	77·5	75·2	73·0	71·8
81·0	84·6	85·0	85·6	84·0	81·0	79·0	78·0	77·6	76·8	75·0	73·6
81·5	83·4	85·0	85·2	83·6	79·6	78·2	77·6	77·0	75·3	71·2	70·4
84·2	84·5	85·1	86·2	85·2	80·5	78·0	77·0	75·4	73·8	72·2	70·8
84·0	84·8	84·8	84·8	83·7	80·0	76·8	75·2	73·8	73·3	72·0	71·4
80·2	83·0	85·9	86·6	85·0	81·2	79·0	77·4	76·8	75·0	74·4	73·2
82·8	85·8	86·5	85·6	84·7	81·7	79·4	78·0	77·0	75·8	74·8	74·2
83·2	83·1	84·2	84·7	83·6	80·0	77·5	77·0	76·4	74·4	72·6	72·2
81·5	82·2	82·9	82·9	82·0	79·2	77·0	76·2	75·0	72·4	71·4	70·3
79·8	80·7	81·9	82·7	81·2	78·6	76·4	75·6	74·8	73·0	70·7	69·6
83·4	87·6	84·8	84·5	83·4	80·2	77·8	76·7	76·2	74·6	71·4	70·8

BOMBAY, 2. 1855, Monthly

Hours, mean time.	January.	February.	March.	April.	May.	June.
Mdn.	71·7	73·9	75·9	78·1	82·4	81·9
1h A.M.	71·2	73·7	75·4	77·9	82·1	81·1
2	70·6	73·2	75·1	78·0	81·8	81·5
3	70·2	72·9	75·1	77·6	81·5	81·3
4	69·9	72·7	74·4	77·1	81·2	81·1
5	69·5	72·1	74·0	76·6	81·7	81·1
6	69·2	71·8	73·8	76·6	81·6	81·5
7	69·4	72·1	75·4	79·6	84·2	82·7
8	71·9	74·7	78·5	82·3	86·8	84·0
9	74·4	77·0	80·8	85·0	88·3	85·4
10	76·3	78·7	82·8	86·0	89·8	86·3
11	78·2	80·1	84·1	87·3	90·9	87·2
Noon	80·2	82·0	85·5	88·0	91·7	87·5
1h P.M.	81·2	83·0	85·7	87·9	92·0	87·6
2	82·0	83·7	85·9	88·2	92·2	87·4
3	81·9	83·5	85·7	88·0	91·9	86·9
4	81·4	83·1	84·9	86·8	91·4	86·4
5	79·3	81·4	83·0	84·6	88·9	85·1
6	76·8	78·6	79·9	82·0	86·3	83·8
7	75·0	77·3	78·5	80·7	84·6	82·7
8	74·4	76·6	77·8	80·0	83·9	82·0
9	73·7	76·0	77·2	79·6	83·4	82·0
10	72·7	75·0	76·6	79·5	83·1	81·9
11	72·1	74·4	76·1	78·9	82·8	81·9
Mean	74·7	76·9	79·3	82·0	86·0	83·8

Means for every Hour.

July.	August.	September.	October.	November.	December.
80·3	80·1	78·6	79·5	76·9	73·8
80·2	79·8	78·6	79·4	76·2	73·8
80·3	79·6	78·4	79·2	76·1	73·5
80·2	79·3	78·3	78·8	75·9	73·1
80·1	79·0	78·2	78·6	75·7	72·9
79·7	78·9	77·8	78·3	75·3	72·6
79·7	79·0	77·9	78·3	75·9	72·3
80·5	80·3	78·9	79·9	76·2	72·7
81·7	81·7	80·7	82·0	78·6	75·2
82·9	82·8	81·9	83·9	80·6	77·3
84·6	84·6	82·7	85·4	82·2	79·3
84·8	85·1	83·9	86·4	84·0	81·5
85·5	86·4	84·9	87·5	86·0	83·3
85·8	86·5	85·3	88·1	87·6	84·8
85·3	86·8	85·7	88·4	88·2	85·6
84·7	86·2	85·6	88·0	88·4	85·6
84·2	85·3	84 7	86·9	87·3	84·6
82·8	83·9	83·2	85·2	84·3	81·4
81·8	82·2	81·3	83·0	82·3	79·3
81·2	81·2	80·2	82·2	81·5	78·4
81·8	80·8	79·5	81·7	80·3	77·7
80·6	80·4	79·2	81·0	79·3	76·4
80·6	80·2	79·0	80·4	78·0	75·0
80·4	80·0	79·0	80·1	77·1	74·3
82·0	82·1	81·0	82·6	80·6	77·7

Bombay, from its position on an island, shows very small variations of temperature, even if we examine the single days. For instance, in the month of May, when changes between rainy storms and a powerful insolation from a brilliant tropical sky are so frequent, differences for the same hour exceeding, in the shade, 6° Fahr. in a whole month are very rare; whilst in the temperate zones, already in Assám and in the Pănjáb, the changes in temperature very frequently suddenly rise to 3 and 4 times this amount.

Also Madrás has a very small variation; both can be considered at the same time as a very good type for the changes in the tropical seas.

"*The local Time*" has a somewhat more uniform influence on the daily range in different climates than perhaps might be expected. For instance, the "*hours*" which most approach the daily mean are nearly the same on the sea-shore as in the interior of the tropical peninsula. In our latitudes the hour of the morning (A. M.) has greater oscillations.

The following table contains the full hours least differing from the daily mean, and I add for comparison here already the same results for Madrás and Ambála. The more detailed values for Madrás are deduced from Goldingham's observations: the decimals of the hour, however, correspond but to very small deviations from the values read at the full intervals of observations, when referred to the thermical scale.

Hours of daily mean.

Months.	Bombay.		Madrás.		Ambála.	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
January	9^h	8^h	$9^h.2$	$7^h.2$	9^h	8
February	9	8	8·8	7·2	8½	7
March	8	6	8·7	7·4	8	7
April	8	6	8·6	7·2	8	7
May	8	6	8·5	6·4	8	8
June	8	6	8·8	7·8	8	8½
July	8	6	9·6	6·6	8	9
August	8	6	8·9	7·5	9	9
September	8	6	8·6	7·9	8½	9
October	8	6½	8·7	6·7	8	8
November	9	8	8·8	6·4	8	8
December	9	8	9·5	8·6	9	8

MADRÁS. Lat. N.: 13° 4′ 12″; Long. E Greenw.: 80° 13′ 56″;

1850, Monthly Means

Hours, mean time.	January.	February.	March.	April.	May.	June.
Mdn. 41m A.M.	73·5	74·3	74·6	80·5	83·1	83·5
1 ,,	72·9	73·7	73·7	79·7	82·6	83·0
2 ,,	72·4	73·0	73·0	79·1	81·9	82·7
3 ,,	71·9	72·2	72·5	78·5	81·2	82·4
4 ,,	71·3	71·6	72·0	78·0	80·7	82·1
5 ,,	70·7	71·2	71·6	77·6	80·5	81·9
6 ,,	70·6	71·2	72·2	79·5	83·5	83·2
7 ,,	72·7	73·8	76·3	83·9	87·2	85·7
8 ,,	76·1	77·1	80·7	87·1	90·2	88·3
9 ,,	79·0	79·9	84·1	89·7	92·5	90·7
10 ,,	80·9	81·5	86·3	91·5	93·5	92·8
11 ,,	81·8	82·3	87·8	92·3	94·0	94·9
Noon 41m P.M.	82·2	82·8	88·4	92·4	94·1	96·4
1 ,,	82·1	82·7	88·5	92·3	93·9	97·7
2 ,,	81·8	82·7	88·4	91·9	93·6	97·0
3 ,,	81·0	82·2	87·7	91·2	92·8	94·7
4 ,,	79·6	80·9	86·3	89·7	91·4	92·2
5 ,,	77·8	79·1	83·7	87·5	89·3	89·5
6 ,,	76·5	77·3	80·8	84·6	86·5	87·2
7 ,,	75·9	76·6	79·3	83·6	85·4	86·1
8 ,,	75·5	76·2	78·2	83·0	84·8	85·4
9 ,,	74·8	75·8	77·3	82·4	84·3	84·8
10 ,,	74·3	75·6	76·5	82·0	83·9	84·4
11 ,,	73·8	75·1	75·7	81·4	83·5	83·9
Mean	76·2	77·0	79·8	85·0	87·3	87·9

Height of the instruments 27 feet above the sea level.

for every Hour.

July.	August.	September.	October.	November.	December.
82·3	81·8	81·0	80·4	75·9	73·6
81·9	81·4	80·6	79·6	75·3	73·3
81·5	80·8	80·0	79·1	74·9	72·8
81·1	80·1	79·6	78·6	74·6	72·4
80·9	79·6	79·4	78·2	74·2	72·0
80·8	79·3	79·0	77·8	73·6	71·7
82·0	80·4	79·6	78·5	74·3	71·6
84·6	83·4	81·6	80·9	75·7	73·4
87·4	86·2	83·8	83·1	77·9	76·0
89·7	88·5	86·0	85·0	80·0	78·3
91·8	90·4	87·6	86·4	81·4	79·7
93·6	91·9	88·7	87·3	82·1	80·2
94·6	92·7	89·3	88·1	82·3	80·6
95·2	92·5	89·6	88·1	82·5	80·7
95·4	92·3	89·2	87·9	82·1	80·2
94·9	91·0	88·4	87·3	81·4	79·6
92·9	90·1	87·1	85·9	80·6	78·6
90·5	88·1	85·5	84·0	79·2	77·2
87·2	85·7	84·0	82·9	78·3	76·0
85·6	84·5	83·2	82·3	77·9	75·4
84·8	83·8	82·7	82·0	77·6	75·1
84·0	83·2	82·2	81·6	77·3	74·8
83·6	82·8	81·6	81·3	77·1	74·5
82·8	82·4	81·3	80·7	76·5	74·0
88·0	85·5	83·8	82·8	78·0	75·9

Calcutta. Lat. N.: 22° 33′ 1″; Long. E. Greenw.: 88° 20′ 34″; Height of the

1855, Monthly Means

Hours, mean time.	January.	February.	March.	April.	May.	June.
Mdn.	62·8	68·7	74·8	78·4	82·3	83·2
1 A.M.	62·1	68·1	74·1	78·1	81·8	82·9
2	61·5	67·5	73·6	77·5	81·5	82·6
3	60·8	67·2	73·0	77·3	81·3	82·5
4	60·2	66·5	72·5	76·8	81·0	82·3
5	59·6	66·1	72·0	76·7	80·9	82·2
6	59·3	65·6	71·7	76·4	81·0	82·3
7	59·0	65·3	71·8	77·0	82·1	83·2
8	61·0	67·6	75·3	79·3	84·2	84·7
9	64·6	70·6	78·5	81·6	86·5	86·4
10	67·9	73·6	81·8	83·9	88·8	88·4
11	70·7	76·1	84·0	86·4	90·5	89·4
Noon	73·2	78·4	86·2	88·5	91·9	90·3
1 P.M.	74·7	79·8	87·5	89·3	92·6	90·0
2	75·6	80·8	88·2	90·4	93·0	89·7
3	75·8	81·2	88·6	90·8	93·1	89·5
4	74·0	80·6	88·2	90·2	92·2	88·9
5	72·5	79·3	86·4	88·5	90·4	87·9
6	70·3	76·5	83·5	85·6	87·8	86·7
7	68·6	74·5	80·8	83·1	85·5	85·6
8	67·1	73·0	79·1	81·6	84·1	84·6
9	65·8	71·7	77·7	80·3	82·9	84·1
10	64·7	70·8	76·8	79·5	82·9	83·7
11	63·8	70·1	75·9	78·9	82·5	83·4
Mean	66·5	72·1	79·3	82·3	85·9	85·6

instruments at the Surveyor-general's office 18 feet above the sea level.

for every Hour.

July.	August.	September.	October.	November.	December.
81·1	81·9	80·8	79·0	70·7	62·6
80·8	81·6	80·7	78·5	70·1	62·0
80·5	81·5	80·6	78·3	69·6	61·3
80·2	81·3	80·4	78·4	69·3	60·7
80·0	81·2	80·1	77·9	68·8	60·1
79·7	81·2	79·9	77·6	68·2	59·6
79·6	81·0	79·9	77·5	67·8	59·1
80·1	81·5	80·5	78·3	68·1	59·1
81·2	82·9	82·0	80·6	71·6	62·0
82·2	84·2	82·7	82·3	74·9	66·2
83·4	85·5	84·2	83·5	76·9	69·3
84·5	86·5	84·7	84·8	79·1	72·2
85·6	87·3	85·3	85·2	81·1	74·8
86·0	87·5	85·4	85·8	82·2	76·3
85·2	87·0	85·9	85·8	82·8	77·2
85·1	86·9	85·1	85·0	82·7	76·9
84·2	86·1	84·1	84·5	80·6	74·6
83·7	85·6	83·1	83·5	78·7	72·7
83·1	84·6	82·3	82·0	76·6	70·4
82·5	83·5	81·9	81·1	75·0	68·2
82·2	83·1	81·6	80·3	73·9	66·8
82·0	82·6	81·3	79·9	72·8	65·6
81·7	82·3	81·1	79·5	72·7	64·5
81·4	82·1	80·8	79·2	71·2	63·8
82·3	83·7	82·3	81·2	74·4	66·9

AMBÁLA. Lat. N. 30° 21′ 25″; Long. E. Gr. 76° 48′ 49″;

1858, Monthly Means

Hours, mean time.	January.	February.	March.	April.	May.	June.
Mdn.	45·4	52·0	58·9	67·5	83·1	90·2
1 A.M.	44·6	50·9	58·2	66·7	81·5	88·7
2	43·7	49·9	57·4	65·9	78·9	87·5
3	42·9	48·8	56·8	65·3	78·6	86·3
4	42·0	48·0	56·2	64·7	78·2	85·3
5	41·6	47·4	55·8	64·7	77·5	84·7
6	40·7	46·8	55·7	67·0	83·9	88·2
7	40·8	48·5	60·0	73·0	89·1	91·9
8	44·0	56·5	64·5	77·1	93·2	94·7
9	50·3	62·7	68·3	81·1	97·2	96·8
10	55·0	66·6	71·7	83·4	100·3	99·1
11	58·1	69·5	73·7	85·5	102·2	101·3
Noon	60·1	71·7	74·5	86·7	103·5	102·6
1 P.M.	60·5	72·8	75·1	87·0	104·1	103·6
2	60·7	73·7	75·5	87·0	104·5	104·3
3	60·7	73·7	75·9	86·5	104·2	104·3
4	59·7	72·5	75·7	86·0	103·4	104·0
5	55·9	69·0	74·0	84·5	100·0	102·3
6	53·7	64·7	69·2	81·9	98·0	100·4
7	51·3	60·9	66·2	77·0	96·2	98·2
8	49·9	57·9	64·0	73·5	92·8	96·3
9	48·4	56·0	62·5	71·6	89·7	94·7
10	47·3	54·2	61·1	70·0	86·2	93·1
11	46·3	53·0	60·0	68·8	85·0	91·8
Mean	50·1	59·5	65·5	76·0	92·1	95·4

Height 1,026 feet.

for every Hour.

July.	August.	September.	October.	November.	December.
81.5	84.0	78.7	65.0	53.0	49.4
80.7	83.1	77.6	63.9	51.3	47.8
80.0	82.2	76.7	62.9	50.4	46.5
79.7	81.2	75.8	61.9	49.5	45.0
79.2	80.4	75.0	61.0	48.6	44.2
79.1	79.8	74.5	60.1	48.0	43.3
80.1	80.6	74.4	60.3	47.7	42.5
81.7	83.5	78.0	65.0	51.9	42.0
83.3	86.0	81.2	71.9	59.8	49.9
84.6	88.3	83.9	78.0	65.5	56.6
85.7	90.9	86.1	81.3	70.3	62.6
86.5	92.5	87.1	84.0	74.5	66.8
87.1	93.7	87.8	85.5	76.5	68.5
87.7	94.7	88.3	86.3	77.9	69.6
88.1	95.1	88.6	86.6	78.4	70.2
88.1	95.1	88.6	86.6	78.2	69.7
87.9	94.5	88.2	85.3	76.9	68.3
87.1	93.4	87.5	83.5	74.0	65.4
86.3	92.0	86.6	80.1	67.5	60.5
85.0	90.5	85.3	75.7	64.4	57.7
84.4	88.9	83.7	73.0	61.3	56.9
83.7	87.6	82.3	69.6	58.7	54.2
82.8	8[illegible].3	81.0	68.0	56.5	52.4
82.1	85.2	80.1	66.5	54.8	50.6
83.8	87.9	82.4	73.4	60.2	55.9

Bombay, Madrás, and the tropical seas in general had given but little to observe about periodical variation; but these two stations, Calcutta and Ambála, show great differences already in their daily curves.

In Calcutta, as in Bengál in general, the nights are of a much more uniform temperature, also the rise in the morning is not so rapid as farther inland; the month of July, in the height of the rainy season, shows the smallest daily range, not much exceeding 6° Fahr. The rain is cooler than the atmosphere, but very little, and a steamy vapour fills the atmosphere which, we saw, makes the resulting heating power of the direct rays of the sun stronger, and, besides, perspiration *felt* much more than even in the hottest regions of Central and Northern India. For some parts of Eastern Bengál, and particularly for Assám, the fogs of the cool season must be mentioned. They are most regular in the valley of the Brahmapútra, where, from December to February, they often begin early in the afternoon, even as soon as 4^h P.M., and do not generally disappear before 9^h to 10^h A.M.

In Calcutta May is still the hottest month in the general mean, and more so still in the mean of the single hours; in Ambála it is June, but July and August, which we shall see occupy, but little more to the north, the rank of the warmer months, as in the greater part of the northern hemisphere, are even here considerably cooled by the setting in of the rains.

2^h P.M. generally coincides with the time of the daily maximum from Calcutta to Ambála; but in the dry season of Bengál 3^h P.M. is warmer, whilst in the rainy season the predominance of rains in the afternoon makes the time of maximum considerably approach the middle of the day; we find it at Calcutta in July and August at 1^h P.M., in June even as early as Noon. In stations of a central position the maximum shows a tendency to take place later than in general; in Káddapa I obtained 4^h P.M., even in the mean of all the year 1854, warmer than 2^h P.M., but the difference rarely exceeded $\frac{1}{2}$° Fahr.

In the hot season, when the mean temperature in the shade increases so rapidly on proceeding from the sea-shore to the interior, the daily range is also considerably altered, especially by the increase of heat in the afternoon. Many are the instances I might select from the meteorological observations; wherever I could I tried to procure hourly observations, by erecting temporary stations from where my observers had to follow me later. I found it very useful, in order to become thoroughly acquainted with

the type of the climate, to enter the readings, as soon as they reached me, in a paper covered with a network of horizontal and vertical lines, the distances being made to correspond to decimals of a degree, and then to draw the curves.[1] This not only gives an impression far more distinct and more easily retained than numerical tables alone, if you have to compare various climates in succession, but it also best directs the attention to such modifications as deserve peculiar attention at stations to be erected later.

As an example of the variation of temperature in the height of the hot season I give the means of the observations in May I had made at Ranigánj, only 120 miles inland from Calcutta; the extremes here are 77·7 and 101·7, whilst in Calcutta the daily range is limited between 80·9 and 93·0 Fahr.

RANIGÁNJ. Lat. N. 23° 35′; Long. E. Gr. 87° 7′; Height 319 feet.

1857, May, Hourly Means. (Month = 89·4.)

A.M.				P.M.			
Mdn.	84·9	6	77·9	Noon	98·8	6	94·8
1	83·5	7	80·1	1	100·8	7	90·5
2	82·0	8	82·8	2	101·5	8	88·9
3	80·6	9	86·2	3	101·7	9	87·3
4	79·2	10	92·5	4	100·9	10	86·9
5	77·7	11	96·4	5	98·8	11	86·2

In days of "*Hot wind*" the variation becomes very much smaller; even as low down as upper Bengál. The hot winds begin early in April with full power, then a hazy dust generally covers the sky early in the morning; at about 10^h A.M. a dry north-westerly wind springs up, carrying a quantity of solid matter floating in the atmosphere, which often limits for hours the view to a distance of from 20 to 30 feet; occasionally, for a short time, the obscurity of the atmosphere is much increased,

[1] Beobachtungs-Manuscr., Vol. 17, 18, and 19, and Meteor. Manuscr., Book V, containing the curves from Ceylon; Book XXXV those from the eastern Himálaya.—A series of very detailed observations made by Sir PROBY CAUTLEY and Prof. ROYLE at Sahárunpur is published in CAUTLEY's grand work, "On the Ganges Canal." For Kálu station, Chăch Base, the observations of the G. T. S. must be mentioned. Meteor. Manuscr., Book XXIX.

when a sudden gust of wind springs up; and, as I had instances in the Pănjáb, it is not unfrequent that for a moment the progress of a travellers' train is stopped from positive want of light. Beyond the stratum of dust, rarely exceeding, it appears, 600 to 700 feet, the sky is cloudless and the sun pours down his scorching rays with nearly unlimited power upon the clouds of dust; within them his light and his glare is broken; his disk is of an orange tint, and his rays in the height of the storm scarcely appear to affect the thermometer, but the temperature of every surrounding atom is the more suffocating. As long as the hot wind lasts in full power the variations of temperature are very slight; the particles carried about have a temperature of their own, originated on the surface of a soil exposed to the full power of a tropical sun for hours and now but little modified all day long by the sun, except in the very highest parts of the stratum of dust. In many instances I had occasion to remark that it is much more the power of the wind and the greater thickness of dust which causes an increase of temperature than the gradual change in the height of the sun.[1]

In April 1856, when I went up from Bengál to the North-west Provinces, I often had temperatures like those observed as early as April 6th, at Fătigárh (Lat. N. 27° 23′·3; Long. E. Gr. 79° 37′·0; Height 635 feet).

11^h A.M.	100·1	2^h P.M.	99·3	5^h P.M.	98·4
Noon	100·9	3	99·3	6	97·9
1^h P.M.	100·7	4	99·3	7	95·0

In the observations communicated to me from the Medical Stations I frequently find in the Pănjáb days of hot winds end of May and in June exceeding 110° Fahr. But the very hottest days are not even those of hot winds; whilst they blow the full power of the sun does not reach the surface of the earth unbroken, whilst on days "calm and clear," temperatures even exceeding 120° are occasionally observed,—numbers which even when written by your own hand might occasionally appear too unexpected, did such registers not recall at the same time better than many words could do the vivid remembrance of atmospheric and local conditions accompanying the observations.

The daily variation of temperature in the *rainy season* is equally characteristic for the tropics. In this period the absolute heat is not so great, but it is the more oppressive from the quantity of steamy moisture filling the atmosphere, the loss of heat

[1] In my Bangalow I could reduce the temperature to 85° by *tatties*, viz. wettened networks of reed hung down from every opening on the windward side.

by evaporation, and, as I have explained above, also by the radiation[1] being considerably limited. The total amount of daily variation of temperature is very small, but then at the same time it is very irregular too, being materially affected by the hours of the falling of rain; in the beginning and the end of the rainy season the hours of rain are particularly uncertain, and readings like the following are nothing unusual; I select a few examples from my travels through the Jhils of Bengál when sailing across the flooded country on the road from Darjíling to Cherrapúnji.

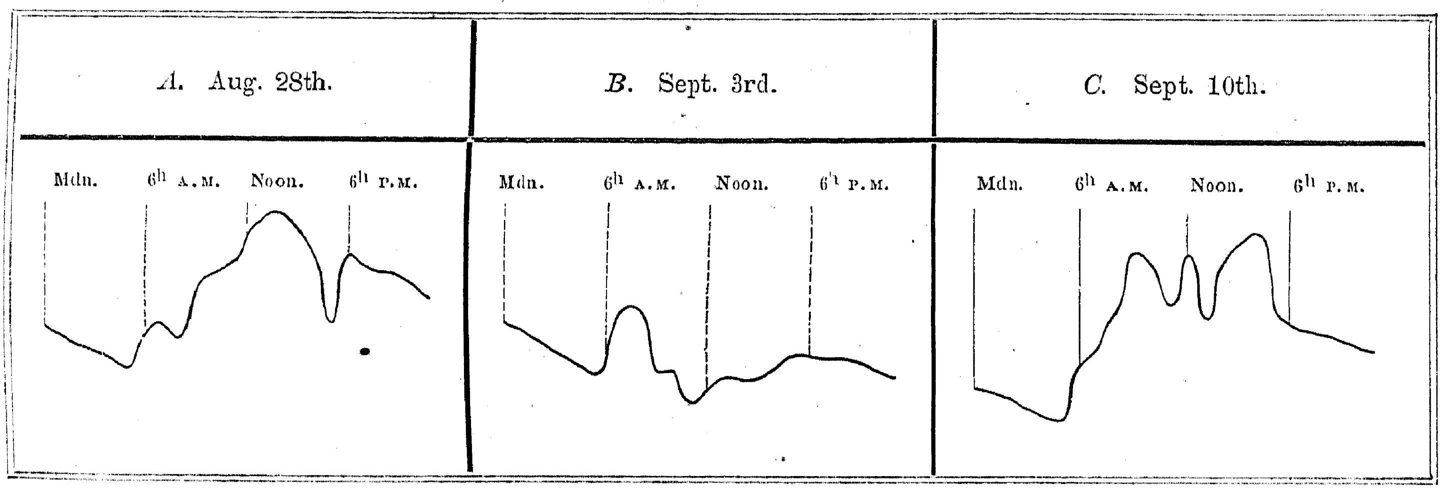
Bengál—Jhils. 1855.

	A. Aug. 28.	B. Sept. 3.	C. Sept. 10.	
Mdn.	80·8	81·6	77·3	Mdn.
1h A.M.	80·4	80·9	77·0	1h A.M.
2	79·9	80·2	76·6	2
3	79·4	79·5	76·3	3
4	79·0	79·0	75·9	4
5	78·4	78·4	75·7	5
6	80·4	79·5	70·6	6
7	81·1	82·2	80·0	7
8	80·4	82·2	82·2	8
9	83·3	78·6	85·6	9
10	84·0	78·6	85·1	10
11	84·7	76·8	82·2	11
Noon	86·5	77·5	85·1	Noon
1h P.M.	87·6	78·6	81·3	1
2	87·8	78·4	84·7	2
3	86·9	78·3	85·8	3
4	85·5	79·0	86·9	4
5	81·8	79·9	81·5	5
6	85·3	79·9	81·1	6
7	84·7	79·7	80·7	7
8	84·7	79·5	80·5	8
9	84·2	79·1	80·1	9
10	83·5	78·8	79·7	10
11	82·8	78·6	79·2	11

[1] See p. 47 to 52.

To facilitate the comparison I add the respective curves in three small diagrams:

(BENGÁL-JHILS, 1855.)



An inspection of the tables and diagrams at once shows the irregularities in the daily variation of temperature. August 28th we see a depression at 8^h A.M., and a second sinking much more considerable at 5^h P.M., followed by a rise of $3\frac{1}{4}°$ Fahr. till 6^h P.M.

September 3rd the temperature is still highest in the early morning, the day before having been free from rain and the sky being clear in the morning; after various vibrations during the day, the curve rises at 5^h P.M., when the sky cleared up again, at about an hour before sunset to the greatest height it had reached since 8^h A.M.

September 10th we see two strong oscillations from 10^h A.M. to 4^h P.M. coinciding with storm and showers of rain.

A thunderstorm, a rain with northerly wind in Central Europe, especially in the Alps, not unfrequently causes depressions very much greater than those alluded to here; but in Europe, also, after smaller depressions, a rise of the temperature does not follow so rapidly again, the heat once being broken. Still farther to the north, in the polar regions, the daily variation disappears completely, particularly during the long polar night.

A modification in the daily variation peculiar to tropical *coasts* is produced by the regularity of the *sea breezes.* In consequence of the difference of temperature between sea and land the equilibrium of the atmospheric strata is altered, and during

one part of the daily period, a refreshing breeze springs up[1] which may be felt, if favoured by the local configuration, even at a considerable distance from the sea-shore. Its beginning coincides with the time of the full power of the ascending current inland; the heated air there steaming up in a vertical direction would produce a vacuum if lateral affluents did not fill it up. The wind here, as generally, if traced to its final conditions must be considered not as beginning where it comes from, but where it goes to; it is the repetition here again of the air rushing to a fire-place first from the surrounding space, and only gradually causing a circulation, into which also the more distant particles are drawn. So, if we watch the first alterations in the direction of smoke or dust, we easily observe that in many cases the "direction" of the current of air has become changed inland a considerable time before the change has reached the sea-shore, but, as was to be expected, in the interior the change is not yet refreshing, for the next regions put in motion are not yet those cooled by resting all day over the surface of the sea. The configuration of the country, the form of the coasts, the direction of the winds predominating from more general causes, must modify the time and the regularity of the breezes for nearly every point of the coasts; most frequently they may be said to begin at about 4^h P.M. and to last till late in the night.

The *land wind* does not set in with the same regularity, nor is the modification it exercises upon the temperature felt so distinctly. The reason is, that where it passes over the land the temperature does not materially differ; when it reaches the sea its heat is rapidly reduced by the evaporation being also considerably increased. This too contributes to our not "feeling" the land wind so distinctly hot as we feel the sea breeze cool, that wind, by the very motion of the air, is felt less hot than air unmoved.[2] In a calm the stratum next to our body so rapidly becomes, comparatively speaking, overheated by the excess of our own temperature; and our own

[1] Difference in temperature with periodic variation is everywhere accompanied by regular alterations in the direction of wind, also in mountains. For details see FOURNET, "Annales de Chimie," LXXIV, p. 337 The "Gletscher wind" I had found in the Alps ("Phys. Geogr.," Vol. I., pp. 368, 393, &c.) was met with in the same form also in the valleys of the Himálaya and Tíbet.

[2] The well-known Pánkahs, huge fans hanging down from the ceiling and kept in vibrating motion, only act by their mechanical power, not by actual alteration of temperature. Even in a ball-room generally the temperature is at once "felt" hotter by the spectator as soon as dancing suddenly ends, although here too the motion could act only mechanically, being in itself a very appreciable source of heat.

evaporation can then but little contribute to cooling us if not supported by a change of air around us.

Morning and evening in the tropics, and their days and nights, have been already so often described, that it is with hesitation I add even the few lines which I think may best conclude in a more general form this sketch of the phenomena of daily variation of temperature.

The seas, the islands, the continental shores, vary in their type of climate only between rain and sunshine, occasional storm or calm; but temperature, the most powerful of all the meteorological elements, is so little affected that regions like the Indian Islands might well be said to enjoy a perpetual season of paradisiacal luxury unbroken by a winter's chills—not even visited by extremes of heat—were they not at the same time to our feeling, as well as to that of still many an other human tribe, the region of a relaxation by steam and vapour which a European cannot overcome in the long run, either physically or mentally.[1]

The farther we penetrate into the interior of the Indian peninsula—large enough in itself to show the effects of a continent, though cut off from Central Asia by the gigantic walls of the Himálaya, the Karakorúm, and the Kuenlúen—the greater we find the contrasts in the *daily* variations as well as in the seasons.

A January morning in the north of the Pănjáb is cooler than many a part of southern Europe; the minimum at sunrise, as low as 40 to 42° Fahr., is felt chilly, but a brilliant sky and a powerful sun make the refreshing air of such mornings a very little later a delight for every European feeling. Mind, it is the same region I spoke about in reference to its dust storms and occasional calms in summer not long ago.

The middle of the day in tropical latitudes shows the same type everywhere, unless modified by the setting in of clouds and rain. Birds,[2] most generally kites or parrots, covering the sacred ficus-trees along a tank, are the creatures we chiefly see or hear; so long as the heat is greatest, shelter is a necessity for man and beast. It is true, it is a grand sight too this disk of a sun—more brilliant than fancy ever could imagine it

[1] This may be considered also as the predominating idea of the reporters to Parliament when in 1860 the questions about Colonisation and Settlement in India were answered. Our experience during the travels—as far as our occupations allowed at the same time to judge of practical matters, often of so material local modifications—is contained in the "4th Reports," pp. 1 to 10, and chiefly refers to meteorological conditions.

[2] No singing bird is indigenous in the tropics, and all experiments of acclimatisation have also remained without success. Even introduction has generally failed.

before the eye had actually felt it—as well as all the charms of nature it produces; but at the same time man feels but made to admire, not to enjoy it.

Early in the afternoon everything awakes to life again, the more rapidly as the setting of the sun is followed here by night so suddenly. Large towns then particularly develop their character in the colours most gay and most varied, and nowhere can an Indian evening be better enjoyed than in one of the large sea-ports, when the thoughts of the fatigue of the day are mildly blown away by a refreshing breeze.

The daily variation of temperature, besides the *general* features already detailed, also showed one more modification of a minor character, but perhaps not less peculiar to the tropics: a *second depression*, after sunrise. In low latitudes, where the sun also near the horizon so rapidly changes its vertical height, the influence before its rise is limited to a very short period; radiation continues to the very moment of sunrise, which in general coincides with the time of the minimum of temperature;[1] sunrise is also the time of maximum of dew and moisture in the lowest stratum. With the first rays of the sun the temperature of the atmosphere increases, but at the same time the *relative* moisture becomes reduced, and the rest of vesicular vapours, the frequent haze of the tropical morning, becomes dissolved. The dissolving makes heat latent, the greater dryness increases the radiation: both effects combine to produce the result of a second depression of temperature chiefly felt in the tropical seas and along the sea-shores; inland I could rarely trace it, and then invariably found it limited to periods of unusual moisture. The second sinking of the temperature does not fall so low as at sunrise, but it was appreciable enough to be distinctly observed.

Already during our voyage we had occasion to observe it the very first days we passed on the Red Sea; the thermometers on deck were read by a little telescope to avoid personal approach; and, to complete the control, I also observed a dry and wet bulb placed on the foretop, besides those read on deck. Both pairs of instruments showed a quite satisfactory coincidence in the form and in the time of their radiation,[2] the result being that 20 to 25 minutes after sunrise the temperature fell again

[1] In great elevations, here as well as in the Alps of Europe, the action of the sun's rays begins considerably earlier. See "Phys. Geogr. of the Alps," Vol. II., pp. 278 to 280, and "Results," Vol. V., the Chapter "On Insolation and Radiation."

[2] The thermometers on deck were 22 feet distant from the sea, the foretop was 54 feet above the deck (= 76 feet above the sea).

for 0·8° Fahr. on an average. This I also found later nearly regularly on every clear morning on the Indian coasts of the Arabian Sea and along the Bay of Bengál.

At Calcutta, also, in General THUILLER's observatory, I had frequently occasion to observe it, and to make it remarked by the assistants, nor did I fail to direct the attention of the observers to it; if it had not been noted till now in the "five minute observations," the reason is, as was quite correctly remarked to me, that in consequence of the instruments being put up under a strong protection against the sun's rays, they were not quite so rapid in their indications as mine, put up more freely and nevertheless sufficiently protected for these morning experiments. Also in the interval of five minutes occasionally a change may have passed unobserved.

As far inland as Pátna and near Silhét I had occasion to observe the second depression after sunrise on unclouded mornings. At Pátna it was in March 1857, in the Silhét Jhīls, Sept., 1855; the time was 12 to 16 minutes after sunrise, but the difference did not amount to more than 0·6° Fahr. From Pátna I still obtained observations, made by my assistant, Lieut. ADAMS, in August, September, and October 1857. In August and September the second sinking remained limited to 0·1° or 0·2° Fahr., and was rarely observed at all. In October a second depression of 0·5° Fahr. to 0·6° Fahr. generally followed the absolute minimum within 25 to 30 minutes. The moment of the absolute minimum was a little preceeding sunrise. His results were nearly the same at Ranigánj in May and June 1857.

In the Pănjáb I obtained for January 1857 from Hărkíshen's observations as an average:

5^h	40 A.M.	41·0° Fahr.
6	10	42·2° ,,
6	30	41·5° ,,

From this moment the rising went on steadily. In February already the second minimum is very rare; in March (1857) my brother ADOLPHE no longer found any analogous depressions, nor had we occasion to observe them in the Himálaya or in Tíbet.

V. CALCULATION OF THE DAILY MEAN.

Importance of selecting hours in calculating the mean.—Arbitrary values of many of the previous publications.—Combinations generally used: $\frac{6^h + 2^h + 10^h}{3}$. $\frac{7^h + 2^h + 2 \times 9^h}{4}$. max. and min. $\frac{SR. + 4^h}{2}$.—Comparison of the results.

Before extending the considerations about variation to the yearly period the *calculation of the mean* has to be analysed, as it is the selection of the hours of observation and their combination which so materially modify every result when hourly observations cannot be procured.

The meteorological registers as proposed for India by the Medical Board, were intended to contain when complete, Sunrise, 9^h 50′ A.M., Noon, 2^h 40′ P.M., 4^h P.M., Sunset, 10^h P.M. These hours were to include the extremes of heat and pressure, and presented at the same time observations sufficiently numerous and with the desirable intervals. Occasionally also registering instruments were employed.

In the manuscript materials I could procure 10^h P.M. is observed scarcely anywhere, whilst *SR.*, 4^h P.M., and *SS.* are those most generally kept up.

The hours of observation used by the continental observers of Europe are most generally 6^h A.M., 2^h P.M., 10^h P.M., or 7^h A.M., 2^h P.M., 9^h P.M.; these hours are selected with a more direct view to the final calculation of the true mean.

In order to deduce the daily mean from a limited number of observations, the distribution of the hours, or, if the readings are made already, the selection of those to be combined, is a matter of the greatest importance. When I come to examine the materials officially published, it will be seen that the "daily means" sent to Europe, as also those recently published in the Parliamentary Sanitaria Reports, were some-

times deduced from the extremes, and much more frequently included, besides the hottest and the coolest hour, a variable quantity of the hours from *SR.* to 10 P.M. mentioned above. It is evident that most of the values obtained must be too warm, since the mean of the extremes already approaches the true mean, and, sunrise and 10^h P.M. excepted, all the other hours mentioned above, also sunset in the tropics, are decidedly above the mean.

The accuracy of the combinations used for calculating the mean is sufficiently tested by comparing it with the mean of the 24 hours; the latter can be considered as identical with the true mean, viz. with that including an indefinite number of observations in intervals infinitely short.

The mathematical expression of the temperature at any time, of the curve and its mean value, is obtained by the formula

$$t = T + a \sin(\mu + \alpha) + b \sin(2\mu + \beta) + c \sin(3\mu + \gamma) + \dots$$

where μ is the horary angle of the sun counted from noon, t is the temperature at a given time, T, a, b, c, α, β, γ are constants found by the method of least squares,[1] T becoming the true mean of the day.

In the "Physical Geography of the Alps" I gave some details about this method: it had been employed before by KÄMTZ, CARLINI, H. SCHMIDT, &c., and is particularly well described by BRAVAIS.[2]

In the selection of stations for testing a formula their position and the topographical conditions are equally important with the possession of detailed observations; only such combinations as answer for stations very much differing in their climatological character have the chance of being most correct also for every part of the year, and for shorter periods, such as days or parts of a month.

I had occasion to profit in this respect not only by the well-known tropical observatories of Bombay, Calcutta, Madrás, Trivándrun—all of which, however, show a certain uniformity, being situated close to the sea-shore; but I also could add details from the Pănjáb and various parts of the Himálaya and Tíbet.

Before arriving at satisfactory results I had to try various methods. Frequently I found them answering for certain regions but not in general; the principal

[1] See "Physical Geography of the Alps," Vol. II., p. 310.

[2] Sur la manière de représenter les variations diurnes ou annuelles des élements météorologiques par des séries trigonométriques. Voyages en Scandinavie par GAIMARD, Vol. II., pp. 291-333.

reason was sunset being nearly throughout the latest hour of observation. These researches, however, I have not introduced here; I limit myself to the comparison of $\frac{6^h \text{ A.M.} + 2^h \text{ P.M.} + 10^h \text{ P.M.}}{3}$, $\frac{7^h \text{ A.M.} + 2^h \text{ P.M.} + 2 \times 9^h \text{ P.M.}}{4}$, max. and min., the extremes with one hour more, and $\frac{SR. + 4^h \text{ P.M.}}{2}$.

a. $\frac{6^h \text{ A.M.} + 2^h \text{ P.M.} + 10^h \text{ A.M.}}{3}$. This is the series of hours proposed by DOVE[1] as one well adapted for the most varied climates; *uniformity in observation* is, besides, an important element for scientific materials. It also has the advantage of being based upon equidistant hours which include an hour very near the maximum (2^h P.M.). For the tropics, too, the numerical tables pages 80 to 89 show it to be one of the best to be proposed; but in India its practical introduction is a little interfered with by the late evening hour, when, at least in hospitals and medical observatories, assistants are rarely at hand.

b. $\frac{7^h \text{ A.M.} + 2^h \text{ P.M.} + 2 \times 9^h \text{ P.M.}}{4}$. This series, the old Mannheim system as modified by KÄMTZ,[2] has about the same difficulty for practical introduction as the one just described; its results would be quite satisfactory.

c. Maximum and minimum. The extremes, or, at least, *SR.* and the hottest hour of the day, are generally included in the series of observations I obtained. HUMBOLDT, in his travels to the American tropics, had shown that their plain arithmetical mean is a very valuable first approximation, but its deviations from the true mean remain still pretty important, particularly for regions with a great daily range of temperature. It can be much improved by combining these two elements in the form

$$T = m + v\ (M - m)$$

where m is the minimum, M the maximum, and v a coëfficient variable with the climate in general and with *the different months.*[3]

[1] The results of this formula, compared with various means calculated from other combinations, were published by DOVE with great care for 29 stations, in the Transact. of the Berlin Acad., 1846, pp. 81 to 136, and pp. 269 to 272 "Ueber die täglichen Veränderungen der Temperatur der Atmosphäre."

[2] See KÄMTZ, "Lehrbuch der Meteorologie," Vol. I., p. 97, &c.

[3] HALLSTRÖM, in Pogg. Annalen, IV., pp. 373-419.

d. The extremes combined with one hour more. By adding still one hour, for instance 9^h A.M., and by putting

$$T = xm + y\,M + z\,9^{h}\ \text{A.M.}$$

I had found that x, y, z can be considered as constants of the mean value *throughout the year*, and the numeric values of the coëfficients I had obtained, then for the Alps,[1] present themselves as practical also for the tropics.

They are $x = 0\cdot 4$ $y = 0\cdot 5$ $z = 0\cdot 11$; a few instances will be sufficient to show that the means so calculated ($= a$) differ but little from the mean of the 24 hours ($= A$); I select two stations and three months most widely differing in their climatological character.[2]

	Calcutta.			Ambála.		
	a	A	$A—a$	a	A	$A—a$
January.	66·9	66·5	— 0·4	50·2	50 1	— 0·1
May	87·2	85·9	— 1·3	91·2	92·1	+ 0·9
August	84·7	83·7	— 1·0	87·7	87·9	+ 0·2

e. $\dfrac{SR. + 4^{h}\ \text{P.M.}}{2}$. As an examination of the material concerning Indian temperature soon showed me that the mean of the extremes was generally a little too warm, whilst nearly all the stations contained the hour of 4^h P.M., I was led to try whether the combination of the minimum or sunrise (both can be considered as nearly identic for the tropics) and 4^h P.M. would not better correspond to the true mean; so they did without any additional modification of coëfficients throughout the year, and my calculations were even much more satisfactory than at first I could expect.

In the following *tables of comparison* I give the values calculated by different formulæ; I have also added details for High Asia, together with some materials for the temperate zones.

[1] "Physical Geography of the Alps," Vol. II., p. 324.

[2] The method employed can be used in any similar case. I may be allowed therefore to repeat here the formulæ required:

If

f = the true mean, h_1, h_2, h_3 = the three periods of observation = x, y, z, the respective coëfficients, we obtain their values from the formulæ:

$$x\,\Sigma h_1^{\,2} + y\,\Sigma h_1\,h_2 + z\,\Sigma h_1\,h_3 - \Sigma h_1\,f = 0$$
$$x\,\Sigma h_1\,h_2 + y\,\Sigma h_2^{\,2} + z\,\Sigma h_2\,h_3 - \Sigma h_2\,f = 0$$
$$x\,\Sigma h_1\,h_3 + y\,\Sigma h_2\,h_3 + z\,\Sigma h_3^{\,2} - \Sigma h_3\,f = 0$$

The values in these tables are the corrections to be applied, viz., the sign + being prefixed shows that the value obtained by the formula must be increased, the sign — that it must be diminished for the number following.

For Bombay and Calcutta I had the hourly observations for every day of the year, Sundays excepted; I chose the year 1855, since in general it is least distant from the period of the other observations. For Tónglo and Falút, Islamabád, and Leh, the values could be given with such detail for one month only. For Ambála I had no quite complete series of hourly observations, but I could easily substitute the values deduced from the curves of daily variation, for which, by the particular care and accuracy of the observer, Dr. TRITTON, I was supplied with an unusually large number of observations, including registering instruments and isolated observations during the night.[1] A station in the Pănjáb was the more welcome as by the great variation also errors would become the more apparent in case the formula employed was insufficient. (In Bombay one full hour only has average variation of 0·1° Fahr.)

Also the observations of Capt. ELLIOT at Singapúr, from 1841 to 1845, offer hourly values; but, as Colonel JACOB explains in his introduction, the hourly variation cannot be trusted, "the mean daily range from 1841-3 being only 4·6° while in 1844-5 it mounts to 12·1° Fahr., and the mean temperature of the year continues nearly constant. It is understood that during the first part of the time the thermometers were kept within the Observatory, but no note is made of the time when they were moved outside. From the observations in 1844-5 the time of the highest temperature appears to be about $0^h \cdot 23$ and of the lowest about 18^h, but the indications are not sufficiently regular to infer this with certainty."[2]

[1] For further details see under the head of the respective stations.—L.a.S.L. means Little above the level of the sea.

[2] Also for many of the hourly observations made on the 21st of the month I tried $\frac{SR. + 4^h}{2}$, with quite satisfactory results, when compared with the other formulæ; it would be too long, however, to enter here into such isolated details.

A. *From India, the Himálaya, and Tíbet.*

Bombay, in the Kónkan.

Lat. N. 18° 53′ 30″; Long. E. Gr. 72° 49′ 5″; Height L.a.S.L.

1855	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
January	74·7	− 0·6	− 0·9	+ 0·1	0
February	76·9	− 0·5	− 0·8	+ 0·1	0
March	79·3	0	− 0·5	+ 0·5	+ 0·4
April	82·0	+ 0·3	− 0·4	+ 0·6	+ 0·3
May	86·0	− 0·3	− 0·7	+ 0·4	+ 0·2
June	83·8	+ 0·1	− 0·5	+ 0·2	+ 0·3
July	82·0	+ 0·1	− 0·7	+ 0·1	+ 0·3
August	82·1	− 0·5	− 0·7	+ 0·4	+ 0·1
September	81·0	− 0·2	− 0·7	+ 0·1	+ 0·3
October	82·6	0	− 0·7	+ 0·2	0
November	80·6	− 0·7	− 1·2	− 0·1	− 0·1
December	77·7	− 0·7	− 1·2	+ 0·1	− 0·1
Mean of the corrections		− 0·12	− 0·38	+ 0·11	+ 0·08

CALCUTTA, in Bengál.

Lat. North 22° 33′ 1″; Long. East Green. 88° 30′ 34″; Height L. a. S.L.

1855.	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
January	66·5	0	— 0·9	0	0
February	72·1	— 0·8	— 1·1	— 0·3	— 0·3
March	79·3	— 0·6	— 0·8	+ 0·4	+ 0·5
April	82·3	0	— 0·3	+ 1·1	+ 1·3
May	85·9	— 0·6	— 1·1	+ 0·3	+ 0·7
June	85·6	+ 0·1	— 0·6	+ 0·4	+ 0·3
July	82·3	+ 0·4	— 0·5	+ 0·1	0
August	83·7	+ 0·2	— 0·5	+ 0·3	+ 0·3
September	82·3	+ 0·3	— 0·6	0	+ 0·1
October	81·2	+ 0·2	— 0·4	+ 0·3	+ 0·2
November	74·4	+ 0·2	— 0·9	0	+ 0·3
December	66·9	+ 0·1	— 1·2	0	0
Mean of the corrections		— 0·02	— 0·37	+ 0·11	+ 0·14

AMBÁLA, in the Pănjáb.

Lat. North 30° 21′ 2″; Long. East Green. 76° 48′ 49″; Height 1,026 feet.

1855	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
January	50·1	— 0·1	— 0·6	+ 0·5	+ 0·5
February	59·5	— 0·1	— 0·7	+ 1·3	+ 1·0
March	65·5	— 0·2	— 0·3	+ 1·4	+ 0·4
April	76·0	+ 0·7	+ 0·2	+ 2·3	+ 0·2
May	92·1	+ 1·7	+ 1·1	+ 0·5	— 1·1
June	95·4	+ 1·2	+ 0·9	+ 0·2	— 1·0
July	83·8	+ 0·8	+ 0·2	+ 0·1	+ 1·3
August	87·9	+ 1·1	+ 0·5	+ 0·6	+ 2·0
September	82·4	+ 1·1	+ 0·9	+ 1·1	— 0·4
October	73·4	+ 0·3	+ 0·1	+ 1·8	+ 0·7
November	60·2	— 1·9	— 2·2	— 0·7	— 1·7
December	55·9	+ 0·8	— 0·2	— 0·9	+ 0·8
Mean of the corrections		+ 0·41	— 0·01	+ 0·58	+ 0·22

Tónglo Peak, in Síkkim.

Lat. North 27° 1′ 50″; Long. East Green. 88° 3′ 55″; Height 10,080 feet.

1855	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
May	48·1	+ 0·5	— 1·5	— 0·2	0

Falút Peak, in Síkkim.

Lat. North 27° 6′ 20″; Long. East Green. 87° 59′ 0″; Height 12,042 feet.

1855	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
May	46·9	— 0·1	— 0·5	0	0

Islamabád, in Kashmír.

Lat. North 33° 44′; Long. East Green. 75° 8′; Height 5,160 feet.

1856	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
October	51·3	+ 0·7	+ 0·3	+ 1·3	— 0·7

Leh, in Ladák.

Lat. North 24° 8′ 21″; Long. East Green. 77° 14′ 36″; Height 11,527 feet.

1856	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
September	60·1	— 0·1	— 0·2	+ 0·7	— 0·2

B. *From the temperate zone, at low elevation.*

ROME. Lat. North 41° 54′; Long. East Green. 12° 25′; Height 170 feet.

1856	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
January	45·95	− 0·07	− 1·15	− 0·22	+ 0·09
July	75·47	+ 0·36	+ 0·20	+ 1·62	+ 0·97

GREENWICH. Lat. North 51° 29′; Long. East Green. 0° 0′; Height 156 feet.

1856	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
January	35·45	− 0·02	− 0·40	− 0·31	− 0·22
July	59·65	+ 0·40	− 0·34	+ 0·45	− 0·13

ST. PETERSBURG. Lat. North 59° 36′; Long. East Green. 30° 18′; Height L.a.S.L.

1856	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
January	13·57	+ 0·16	− 0·11	− 0·29	− 0·25
July	62·37	− 0·12	− 0·13	+ 0·47	− 0·11

TORONTO. Lat. North 43° 40′; Long. West Green. 79° 22′; Height 340 feet.

1856	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
January	26·37	+ 0·22	− 0·36	− 0·18	− 0·40
July	65·60	− 0·06	− 0·07	+ 0·94	+ 0·20

C. *Types of Alpine climate.*

1856	Mean	$\frac{SR + IV}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI + II + X}{3}$	$\frac{VII + II + 2.IX}{4}$
GENEVA. Lat. North 40° 12′; Long. East Green. 6° 10′; Height 1,334 feet.					
January	30·81	— 0·13	— 0·54	— 0·18	— 0·16
July	64·16	+ 0·59	+ 0·43	0	— 0·81
ST. BERNHARD-HOSPITAL. Lat. North 45° 50′; Long. East Green. 6° 6′; Height 8,108 feet.					
January	13·41	+ 0·14	— 0·31	+ 0·02	— 0·02
July	42·84	+ 0·61	— 0·18	0	— 0·31

The circumstance that the means obtained from $\frac{SR + 4^h \text{ P.M.}}{2}$ allowed so general an application was the more welcome to me as nearly all the materials included these elements. Considering the large number of stations to be calculated its simplicity is also of some importance. In case, therefore, the number of daily observations must be somewhat limited SR and 4^h P.M. are to be considered as quite sufficient, 4^h P.M. giving for the tropics at the same time a good and comparable representation of the average afternoon temperature. If a barometer too is kept at the station, the hour of 10^h A.M. may be added next, in order to allow the observer to judge of the barometrical extremes of the day. *The hours of observation*[1] are communicated at the head of each station; but in order not to take up too much space with the tables, I limited myself in general to giving SR and 4^h P.M. only, or the extremes when registering instruments had been employed; also in such cases, however, for deducing the mean SR and 4 P.M. were preferred.

For facilitating the comparison of observations taken at sunrise with others taken at fixed hours, I add an approximate general table of sunrise and sunset calculated for Indian stations.[2]

[1] For some stations the hours of observation were not the same throughout the whole period: such alterations will be found communicated in detail. For my calculation of the means, in most instances, they were of no importance, as, with very rare exceptions the principal hours, SR and 4^h P.M., remained included throughout.

[2] The table refers to the year 1855 and to the longitude of Calcutta. For smaller differences it must be kept in mind that the equation of time (Mean time — True time) does not remain the same for sunrise and sunset, and varies in different years as well as in different longitudes.

Approximate True Time

The Time of Sunrise and Sunset is to be reckoned
The Mean Time is obtained

Sunrise.

Equation of Time, at Noon: + = Sun after Clock; − = Sun before Clock (first column) | − = Sun before Clock; + = Sun after Clock (second column).

Equation of Time, at Noon		Date		Lat. 5°	8°	10°	12°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°
				h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
− 1m.		22	December. 22	6 9	6 14	6 18	6 21	6 25	6 27	6 29	6 31	6 32	6 34	6 36	6 38	6 40	6 42
+ 1	− 4	27	17	9	14	18	21	25	27	28	30	32	34	36	38	40	42
+ 4	− 6	January. 1	12	8	14	17	21	24	26	28	30	32	31	36	38	40	42
+ 6	− 8	6	7	8	14	16	20	24	26	28	29	31	33	35	37	39	41
+ 8	− 10	11	2	8	13	16	20	23	25	27	28	30	32	34	36	38	40
+ 10	− 12	16	November. 27	8	12	16	19	22	24	26	27	29	31	32	34	36	38
+ 12	− 14	21	22	7	12	15	18	21	22	24	26	27	29	31	32	34	36
+ 13	− 15	26	17	7	11	14	17	20	21	23	24	26	27	29	30	32	34
+ 14	− 16	31	12	6	10	13	15	18	19	·21	22	24	25	26	28	29	31
+ 14	− 16	February. 5	7	6	9	12	14	16	17	19	20	22	23	24	26	27	28
+ 15	− 16	10	2	5	8	10	12	15	16	17	18	19	21	22	23	24	25
+ 14	− 16	15	October. 27	4	7	9	11	13	14	15	16	17	18	19	20	21	22
+ 14	− 15	20	22	4	6	8	10	11	12	13	14	15	16	16	17	18	19
+ 13	− 15	25	17	3	5	7	8	10	11	11	12	13	14	14	15	16	17
+ 12	− 13	March. 2	12	3	4	5	6	8	8	8	9	10	10	11	12	·12	13
+ 11	− 12	7	7	2	3	4	5	6	6	6	7	7	8	8	8	9	10
+ 10	− 11	12	2	1	2	2	3	4	4	4	4	5	5	5	6	6	6
+ 9	− 9	16	September. 28	1	1	1	2	2	2	2	2	3	3	3	3	3	3
+ 7	− 8	21	23	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0
+ 6	− 6	26	18	5 59	5 59	5 59	5 58	5 58	5 58	5 58	5 58	5 57	5 57	5 57	5 57	5 57	5 57
+ 5	− 4	30	14	59	58	58	57	56	56	56	56	55	55	55	54	54	54
+ 3	− 3	April. 4	9	58	57	56	55	54	54	54	53	53	52	52	52	51	50
+ 2	− 1	9	4	57	56	55	54	52	52	52	51	50	50	49	48	48	47
0	0	14	August. 30	57	55	53	52	50	49	49	48	47	46	46	45	44	43
− 1	+ 2	19	25	56	54	52	50	49	48	47	46	45	44	44	43	42	41
− 2	+ 3	24	19	56	53	51	49	47	46	45	44	43	42	41	40	39	38
− 3	+ 4	30	14	55	52	50	48	45	44	43	42	41	39	38	37	36	35
− 4	+ 5	May. 5	9	54	51	48	46	44	43	41	40	38	37	36	34	33	32
− 4	+ 6	10	4	54	50	47	45	42	41	39	38	36	35	34	32	31	29
− 4	+ 6	16	July. 29	53	49	46	43	40	39	37	36	34	33	31	30	28	26
− 4	+ 6	21	24	53	48	45	42	39	38	36	34	33	31	29	28	26	24
− 4	+ 6	26	18	52	48	44	41	38	36	34	33	31	29	28	26	24	22
− 3	+ 6	31	13	52	47	44	40	37	35	33	32	30	28	26	24	22	20
− 2	+ 5	June. 5	8	52	46	44	40	36	34	32	31	29	27	25	23	21	19
− 1	+ 4	11	3	52	46	43	39	36	34	32	30	28	26	24	22	20	18
0	+ 3	17	27	51	46	42	39	35	33	32	30	28	26	24	22	20	18
+ 2m.		22	22	5 51	5 46	5 42	5 39	5 35	5 33	5 31	5 29	5 28	5 26	5 24	5 22	5 20	5 18
			Lat.	5°	8°	10°	12°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°

of Sunrise and Sunset.

when the body of the Sun is quite above the Horizon.
by adding the Equation of Time.

Sunset.

24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°	36°	Date.		Date.		Equation of Time, at Noon.	
h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.						
6 45	6 47	6 49	6 51	6 54	6 56	6 58	7 1	7 3	7 6	7 8	7 11	7 14	22				+ 2	
44	46	49	51	53	56	58	0	3	5	8	10	13	27		17	June.	+ 3	0
44	46	48	50	52	55	57	6 59	2	4	7	9	12	3		11		+ 4	— 1
43	45	47	49	51	53	56	58	7 0	3	5	8	10	8	July.	5		+ 5	— 2
41	43	45	47	50	52	54	56	6 58	7 1	3	6	8	13		31	May.	+ 5	— 3
40	41	43	45	47	49	51	54	56	6 58	7 0	7 3	5	18		26		+ 6	— 4
38	39	41	43	45	47	49	51	53	55	6 57	6 59	7 2	24		21		+ 6	— 4
35	37	38	40	42	44	46	48	50	52	54	56	6 58	29		16		+ 6	— 4
32	34	35	37	38	40	42	43	45	47	49	51	53	4	August.	10		+ 6	— 4
30	31	32	34	35	37	38	40	42	43	45	47	48	9		5		+ 5	— 4
27	28	29	30	32	33	34	36	37	39	40	42	44	14		30	April.	+ 4	— 3
23	24	26	27	28	29	30	31	33	34	35	37	38	19		24		+ 3	— 2
20	21	22	23	24	25	26	27	28	29	30	31	32	25		19		+ 2	— 1
18	18	19	20	21	22	22	23	24	25	26	27	28	30		14		0	0
14	14	15	15	16	16	17	18	19	20	20	21	22	4	September.	9		— 1	+ 2
10	10	11	11	12	12	13	13	14	14	15	16	16	9		4		— 3	+ 3
6	7	7	7	8	8	8	8	9	9	10	10	10	14		30	March.	— 4	+ 5
3	3	4	4	4	4	4	5	5	5	5	5	5	18		26		— 6	+ 6
6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	23		21		— 8	+ 7
5 57	5 57	5 56	5 56	5 56	5 56	5 56	5 55	5 55	5 55	5 55	5 55	5 55	28		16		— 9	+ 9
54	53	53	53	52	52	52	52	51	51	50	50	50	2	October.	12		— 11	+ 10
50	50	49	49	48	48	47	47	46	46	45	44	44	7		7		— 12	+ 11
46	46	45	45	44	44	43	42	41	40	40	39	38	12		2		— 13	+ 12
42	42	41	40	39	38	38	37	36	35	34	33	32	17		25	February.	— 15	+ 13
40	39	38	37	36	35	34	33	32	31	30	29	28	22		20		— 15	+ 14
37	36	34	33	32	31	30	29	27	26	25	23	22	27		15		— 16	+ 14
33	32	31	30	28	27	26	24	23	21	20	18	16	2	November.	10		— 16	+ 15
30	29	28	26	25	23	22	20	18	17	15	13	12	7		5		— 16	+ 14
28	26	25	23	22	20	18	17	15	13	11	9	7	12		31	January.	— 16	+ 14
25	23	22	20	18	16	14	12	10	8	6	4	5 2	17		26		— 15	+ 13
22	21	19	17	15	13	11	9	7	5	3	5 1	4 58	22		21		— 14	+ 12
20	19	17	15	13	11	9	6	4	5 2	5 0	4 57	55	27		16		— 12	+ 10
19	17	15	13	10	8	6	4	2	4 59	4 57	54	52	2	December.	11		— 10	+ 8
17	15	13	11	9	7	4	2	5 0	57	55	52	50	7		6		— 8	+ 6
16	14	12	10	8	5	3	1	4 58	56	53	51	48	12		1		— 6	+ 4
16	44	11	9	7	4	2	5 0	57	55	52	50	47	17		27		— 4	+ 1
5 15	5 13	5 11	5 9	5 6	5 4	5 2	4 59	4 57	4 54	4 52	4 49	4 46	22				— 1m.	
24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°	36°						

+ = Sun after Clock. — = Sun before Clock.

— = Sun before Clock. + = Sun after Clock.

The registers from some stations, exceptionally, I found to include only hours which could not well be used for any of the combinations detailed above, such as 10^h and 4^h, or 9^h, Noon, and Sunset. If carefully made, the selection of these hours was no reason for excluding them; but in such cases, for calculating the mean, *coëfficients*[1] had to be deduced from the least distant standard stations, and I proceeded as follows:

1. For observations taken at 3 epochs of the diurnal period:

If we call for the station to be calculated the temperatures at the hours used t_1, t_2, t_3, and the sum of their differences $t_2 - t_1 + t_2 - t_3 = d$ (t_2 being greater than t_1, and t_3), whilst the respective value for the standard station is D; and if we designate the correction necessary for reducing the arithmetical mean of the 3 hours to the true mean, for the new station by c, for the standard station by C, we can put

$$d : D = c : C$$

$$\text{or,} \qquad c = C \frac{d}{D}$$

2. For observations taken only at 2 epochs.

Then the mean only might be deduced from $t_2 - t_1 : T_2 - T_1 = c : C$, which is not quite so accurate as the formula given above. For the stations so calculated the hours will also be found mentioned, and, at the same time they are given as "approximations." The comparatively short distance, however, between neighbouring stations which included SR and 4^h P.M. nearly always considerably increased the probability of obtaining a good approximation.

In some instances "Approximations" without any further detail had to be given, when only one hour, or printed abstracts containing means without details, were at hand.

[1] As the occasion of calculating temperatures by comparison not unfrequently presents itself in various forms, such as reducing an incomplete month to the mean of the full month, of estimating periods not observed for general considerations, &c., I may draw attention to the circumstance, that only *differences* can be compared as detailed here; a direct proportion, such as "the mean annual temperature is ⅓ less than that of September in one place, we will put the proportion the same in a neighbouring spot" (compare CUNNINGHAM's Ladak, p. 183) is quite arbitrary. We have but to reduce for instance Fahrenheit into Centigrade and we see it at once.

VI. THE YEARLY PERIOD OF TEMPERATURE.

THE SEASONS. Limits of rise and fall; the divisions of the natives.
ILLUSTRATING VIEWS OF THE ATLAS; from the tropics.
ABSOLUTE EXTREMES. Data from the globe in general for comparison with the tropics.

THE SEASONS.

In the yearly period of the temperate zones of our hemisphere the temperature begins to rise from the middle of January[1] to the end of July or the beginning of August, when it reaches its maximum; the change is more rapid in April and May, and when decreasing, in September and October, than in the other months.

In the tropics of Asia, though on the same side of the Equator, the time of the periodical rains has sufficient power to modify the direct influence of the height of the sun; the hottest part of the year is the period before June, preceding the rains, which, for the greatest part of India, coincide with our summer, including June, July, and more or less of August. In the southern regions of India and in Ceylon the rains are not so strictly limited to this part of the year only: here rains in the months of the cool season become predominant. This, combined with the double culmination of the sun separated by an interval of several months, materially modifies the seasons and yearly range of temperature, as will be evident from a comparison of the curves added to the plates of the isothermal lines.

[1] In the Polar and Alpine regions February is colder than January. See "Physical Geography of the Alps," Vol. I., p. 359.

Again, on crossing the Tropic of Cancer northwards into the regions which, in consequence of their distance from the sea, are no more reached by the periodic rains, we find the "summer of the northern hemisphere" reappearing with a caloric power which—some regions of Africa perhaps excepted—may not be expected to repeat itself anywhere on the globe.

These very regions are equally remarkable by the depression of their temperature in the hibernal period; in general the annual range of temperature is much smaller in the tropics than in higher latitudes; along the southern coasts it is not unfrequent to see that the *daily* range is much more considerable than the difference of the coolest and the warmest month.

In Southern India many stations, such as Kalikát, Kananúr, Kőchin, Mangalúr, show a sinking of temperature from May to June particularly great; the circumstance that the culmination of the sun takes place twice, combined with the difference in the period of rain between the eastern and western coasts, notwithstanding their distance apart not being very considerable, are the principal causes of these considerable distinctions, which, however, are of a quite regular uniformity for the same place, when different years are compared.

In Kalikát and environs July is even the coolest month of the year; near Kananúr September to November and December to February are unusually warm, but the variation within all the year amounts for the monthly means to 6° Fahr. only.

Near Nellúr January appears to be generally warmer than February; in 1853, here, as in Sálem, February is warmer than March; Dápuli has November particularly warm.

The months differ least along the coasts. In Madrás the mean of January is 75·9, the mean of June 87·6; in Kolómbo it varies between 78·7 and 82·4; at London 37½ and 64; but in Jakuzk, in Siberia, the mean of February is —40·9, that of July 68½° Fahr.

The *seasons* I formed as our European seasons:

a. December, January, February;—*b.* March, April, May;—*c.* June, July, August;—*d.* September, October, November.

For the tropical part of the territory here examined this division into four seasons does not exactly coincide with the limits we observe in nature.[1] March, April, May can be considered in general as the hot season where we have not yet passed

[1] For details compare the introductory description at the head of every one of the groups of the stations.

the Tropic of Cancer; June, July, August are more or less the rainy season; but autumn and the cool season cannot well be separated for many of these stations. In the Pănjáb, already, and more so still in the Western Himálaya, Kashmír, Beluchistán, and the Tibetan provinces, four seasons are met with again; but the principal reason for the formation adopted is, that, for comparison with other parts of the world the same distinctions have to be observed throughout, as already long ago it had become introduced by HUMBOLDT's and DOVE's works.

The Indian terminology introduced in ancient times a division into six seasons, evidently originating along the foot of the Himálaya, where snow, if not felt, is at least seen, and where occasionally a thin stratum of ice may be formed by nocturnal radiation. It has spread itself with Hindu creed and civilisation all over India, even down to Ceylon, notwithstanding such distinctions no longer coincide there at all with the type of the changes in nature.

The Indians begin to count from the setting in of the rains, and the six groups are the following:

Báras, *váras*, properly *Vársha*, the rainy season (also the year): July and August.

Sharád, the close steamy season after rains: about September and October.

Hémanta, the cool season: November and December.

Shíshira, the dewy season, the season of cool mornings and fogs: January and February.

Básant, *vásanta*, spring: March and April.

Gríshma, the brilliant bright, hot season: May and June.

But as to the principal *făsl*, or division, two only are distinguished—those of the two principal groups; to the word *făsl* itself the signification harvest has become transferred. These are:

The *Răbbi*, or spring harvest; it takes place in February and March, its seeds were sown in September and October, as soon as, after the cessation of the rains, the gradual drying up of the moisture from the very surface of the ground allows the cultivation.

The *Kăríf* is the crop of the seeds requiring much moisture, chiefly of rice; the seeds are sown in the very beginning of the rains, when the first heavy showers are followed still by interruptions in the atmospheric precipitation; the crops are gathered about October, even November.

A third crop, that of *Bhádonvi*, including the period of about two months only, from the setting in of the rains to the end of August or September, is limited to fruits of rapid growth, chiefly leguminous plants, such as Dāl (*Pespalum frumentaceum*), vetches, millet, pease, &c. As a part of the year it is included in the season of Kărı́f.

In Tíbet the seasons practically distinguished I found to be only four in number: *chid*, spring; *jar*, summer; *ton*, autumn; *gun*, winter. The Tibetan year begins with February, as in China,[1] whence so many of their political institutions have been derived.

In their *sacred literature*[2] we meet again, pointing to its Indian origin, the six seasons nearly as detailed above; only there, too, the spring is the first season of the year, the others following, as enumerated here:

Chid, spring; beginning in February, lasting till about May.

Soska, } forming together the hot season or summer, the one from May till middle
Char, } of June, the other to end of July.

Ton, autumn; August, September, October.

Gun tag, the upper winter, } including the period of November, December, and
Gun mag, the lower winter, } January.

ILLUSTRATING VIEWS FROM THE ATLAS.

As complement and addition to the sketch of the seasons, I may quote also those of the views of the Atlas coinciding with well-marked meteorological periods. Many are the features by which the aspect of nature is intimately connected with the type of climate; and I was particularly careful in selecting objects in which no exceptional modification of short duration might conceal the predominant character.

The landscapes published in the Atlas up to the present time (April, 1865) may be arranged in the following groups in reference to the meteorological features; to the traveller his painting, if sufficiently large not to exclude those minor details of tint and form which he cannot leave unobserved, recalls the total impression with more power than any

[1] Emil Schlagintweit, "Buddhism in Tíbet," p. 287. Klaproth, "Description du Tibet, traduite du chinois en russe par le Père Hyacinthe, &c.", N. J. Asiat., Vol. IV., p. 138.

[2] Tibetan Dictionaries, *sub. voce* dus.

length of description could do; the effect of the aspect is instantaneous, and, for the author particularly vivid too, by the variety of the recollections called up. Perhaps also the reader in a distant country may find them effective enough to assist him in combining the impression of landscape and climate, of the charms of tropical scenery with the prose of glare and heat and steam.

It would occupy too much space here, where description is not the principal object, to give more than a comparative list; the details, besides, are found in the explanatory lines at the foot of each plate. [1]

Ceylon (Pl. 15) shows the luxuriant features of the Indian archipelago and the tropical coasts—a heat not excessive, but an atmosphere saturated with moisture when not even darkened by clouds and rain.

The *Nílgiris* (Pl. 8), also in the regions of the south, are already some distance from the sea; the fissures in the hardened, reddish soil, not less than the character of the jungle, mark the periodic alteration between dry heat and heavy moisture; the dark tint of the sky is the colour characteristic for these latitudes, but not the only tint of the air we see there; clouds and fogs, also a brilliant pale blue, are not unfrequent in periods of storms and rains.

The *Barér plateau*, from Central India (Pl. 14), was especially selected to show what can be observed of hibernal aspect in these latitudes; the sky is fresh, the green recalls the most brilliant we may have seen in the contemporaneous season in regions like Zante and Cephalonia or along the Sicilian coasts, but here it is of still shorter duration, and but too rapidly the season of unbroken heat follows.

In the view from Upper Assám, more especially in that from the Mahanáddi in the Delta of the Ganges, I tried to show the effect of the rains. In the valley of the *Brahmapútra seen from Tézpur* (Plate 20), it is one of the storms in winter we see, of a few days' duration only, but not unfrequently as strong as any of the rainy season; and the gigantic breadth of the bed of the river, with the numerous isolated islands, are monuments bolder than any could be of the power of the rains streaming down from the eastern mountainous regions.

The view above *Rámpur Bólelah* (Plate 21) shows the Ganges in the period of its greatest height. In the view of *Mahanáddi* (Plate 22) we see a part of lower Bengál at the close of the rains. A muddy bed is filled to its brim with the dark waters of

[1] The numbers are those of the succession of the publication, engraved in the left corner of the plates.

one of the branches of the Ganges; the sky shows the clearing up of a rainy day of August. Though the evening has scarcely begun, lights are already floating down the river, the first marks of the merry gorgeous night which is to follow. For the Indian[1] the rainy season is the one he most enjoys, and which is most celebrated by Híndu festivals; it is to him a time of rest and luxury.

Western Bengál, near Pátna, is represented Plate 22. After the subsidence of the high water some pools and tanks remain, but the lower terraces of the ground are already cultivated, and the uniform cover of water has receded from them nearly as rapidly as the heavy sheets of clouds had disappeared with the change of the wind. The vegetation is fresh though not luxuriant; in the sky we see some airy cirrostratus clouds, their axes coinciding with the direction of the north-westerly current.

In the *General View from the Summit of Parisnáth*, in Bahár (Plate 19), we see the plains at the beginning of the hot season, in March. At this period, when the temperature begins rapidly to become hotter, the air is found with elevation not only cooler, but also charged with a much greater amount of moisture. The impression, as represented in this view is apparently increased by the clouds, when approached and looked at under flat angles. They appear to cover all the sky with a nearly unbroken surface, while the sun, from its almost vertical position, projects their shadows isolated and of the natural size. On many days, however, the outlines of the shadows become nearly imperceptible (as in the view here represented) in consequence of the general haze spread over the country.

The *Biás* and the *Jhílum*, Plate 23, were selected amongst the first views from the Pănjáb, as these rivers show, notwithstanding their breadth and power, that they are not sufficient to alter—as rivers do where they are not too distant from the sea—the dry dessicated features of the country in general; at the same time the refreshing hue of the cool season, in sky and ground, may still be observed.[2]

[1] And so it has been from ancient time. Compare the brilliant description of Indian seasons in "Kalidasa ritusanhāra," edit. by Bohlen.

[2] The regions of High Asia are too varied in height and distance to allow of a comparative analysis here: it will be found connected with the details of the different stations.

ABSOLUTE EXTREMES.

Extremes of *single observations*, "the *absolute* extremes," show a remarkably greater approximation between hot regions and temperate zones in summer than the means of seasons and months; even the means of the day, including all the 24 hours, remain considerably more distant. The difference between single observations of extremes of heat is reduced by the cooler regions becoming occasionally unusually hot; the depression of temperature in the hot regions does not show an analogous variation. This at the same time perfectly coincides with the general law, that in the regions where the daily and yearly range is small the absolute extremes are not unusually great either. In India also, we have therefore to expect them greatest in the Pănjáb, whilst the northern parts of Central Asia show the greatest for our globe in general.

Examples of absolute extremes I have added to every group of the meteorological stations; for general comparison I select here some of the extremes observed till now in various other parts of the globe.[1]

MINIMA.

Nis'hne Udinsk (HANSTEIN), Lat. N. 54° (—62·5° C. = 112½° Fahr. below the freezing point, greatest cold till now observed).	— 80½° Fahr.
Fort Reliance (BACK), Lat. N. 62° 46′	— 70
Port Elisabeth (ROSS), Lat. N. 69° 59′	— 59·½
St. Petersburgh (Imp. Acad.), Lat. N. 59° 56	— 35·7
Greenwich (Royal Observatory), Lat. N. 51° 29′	+ 4·0

MAXIMA.

Murzuk and *Fezzan* (RITCHIE and LYONS), Lat. N. 25½	133
Esne, Egypt (BURKHARDT), Lat. N. 25° 15′	117½
Bassora (BEAUCHAMP), Lat. N. 30° 45′	113½
Paris (HUMBOLDT, personal communication), Lat. N. 48° 50′	101
Greenwich (Royal Observatory), Lat. N. 51° 29′	94·5
St. Petersburgh (Imp. Acad.), Lat. N. 59° 56′	92·1

[1] Even within one year differences can become very great; during this winter in the North of Hungary the thermometer fell to — 22° Fahr., Jan. 18th 1864 where it had marked 89°, Aug. 12th, 1860. (From communications of the Hungarian Academy.)

In India temperatures from 120° to 125° may be considered the maxima; if readings go up still higher, my experience hitherto, from the examination of many stations, convinces me that the instruments were not secured against disturbances by glare or insolation. Occasionally a reading from Kálpi as high as 154° Fahr. is found quoted without further details; but evidently the thermometer, if properly read at all, had been put up under the influence of insolation and heat radiating from walls or the ground. Even the solar action alone, I have full reason to believe, would not have made it rise so high, unless it had a coloured or blackened bulb.

In the littoral regions, and farther to the south, the extremes differ much less altogether; in Madrás, within its long series of observations, the maximum observed till now was 108° Fahr., the minimum 62½° Fahr.[1] The difference between the maximum and minimum is much greater in the temperate zones than it ever becomes within the regions here examined.[2]

As the lowest minimum observed occasionally in the Pănjáb 25° to 20° Fahr. may be considered.

[1] Communicated to me by Major WORCESTER.

[2] Maxima very unusual in Europe were communicated by Mr. QUETELET for Belgium, July 7, 8, and 9, 1853. The maxima all over Belgium ranged between 90·3 and 92·3, the latter being reached at St. Trond, July 8th; and we must be more surprised still by reading how deleterious the effects were, though observations on insolation showed not even a proportionate increase. Want of protection and the heavy dress may have had at least as much share in it as the want of sufficient acclimatisation, if we read that "14 men of the Belgian infantry *died* this day on the march from Beveloo to Hasselt, five *en route* from Jodaigne to Diest." Acad. Royale de Belgique, Bulletins, tome XX, 2me part, pp. 405—415. The impression of such heat is equally increased as its effects when unusual and unaccustomed. Many an Indian resident will be surprised to have a look at the thermometer in Europe when, apparently, it has recalled but too lively Indian feelings. Also two Egyptian scholars who were at the time quoted above at the Brussels Observatory unhesitatingly identified this temperature with some 129° Fahr. they thought to have felt in Egypt. Ibid., p. 407.

VII. NON-PERIODICAL VARIATIONS.

Reduction to and Comparison with true Means. Very little correction required in the tropics. Constancy of the mean total for the globe as far as our meteorological data go back. Modifications of non-periodical variations in different seasons and latitudes.

Variability. Definition: total, absolute, mean variability. Numerical data for India and High Asia. Analysis, and comparison with Europe.

Vestiges of permanent Alteration of our Climate, viz. within the present geological period. Drainage of the Himálayan lakes; gradual exsiccation of those remaining in Tíbet.

REDUCTION TO AND COMPARISON WITH TRUE MEANS.

The annual and monthly means in different years show alterations which make a longer series of observations desirable in the tropics as well as everywhere, for eliminating temporary irregular disturbances. In the northern temperate zone for most parts of the globe the vicinity of neighbouring stations allows one to calculate a reduction to true means (for eliminating the "non-periodical" disturbances), a method first introduced by Dove[1] and applied to a great number of stations.

In the tropics, however, I found the materials not yet continued sufficiently long for applying such considerations with sufficient accuracy, and, again, the irregular modifications from year to year are altogether much smaller than in higher latitudes —the more I had reason to exclude from the general mean such years of which I had to doubt (as detailed at the respective stations) the proper combination of hours; not a century corrects this if so continued, but one such year, if not excluded, can easily conceal the correct result of several others, unless their number is very great already.

[1] Dove, Abhandl. der Berlin. Acad., 1838, pp. 265—415; 1839, pp. 305—440; 1842, pp. 117—241; 1845, pp. 141—320 1852, pp. 85—328; 1856, pp. 121—192; Supplement-Band II., 1855.

The materials I had occasion to examine are included for the greater part between 1850 and 1858. The Central and the North-western Provinces of India show greater irregularities, if we compare the months of different years, than the places within a small distance from the sea-coast; altogether, also in reference to the non-periodical variations, a certain uniformity can be observed, as was to be expected, within regions of the same monsoons and rainy seasons.

On an inspection of any of the tables of some extent, such as Calcutta, Madrás, &c., we are at once surprised by the small variation, if we remember European climates; and the modifications of harvest depend much more upon the quantity and distribution of rain, than upon temperature, which (it is characteristic for the tropics) even for the vegetation never becomes too cool, but easily too hot or rather too dry.

It is one of the most interesting discoveries of meteorology, that the general mean-total of temperature on the globe would in all probability be found the same as far as we can judge, if any two years are compared, had we but a sufficient number of stations regularly spread over all the globe;[1] and were the two hemispheres compared separately, the resulting general mean would be about 5·5° Fahr. warmer in the northern than in the southern hemisphere.[2]

For the tropics a smaller number of years is required for obtaining a sufficient accuracy in reference to the mean.[3] Without this advantage the working out of the materials before me would have become particularly difficult in reference to deducing general results, such as isothermal lines, &c., since an analogy in the deviation cannot be traced between Indian and European observations; a year too cold in the Mediterranean may have any other type in India, and as yet we have no intermediate stations between them to guide us. Amongst the years most frequently represented in the following lists, 1852, January to April, is somewhat below the mean; 1854 is a little too warm; May 1853, from 10th to 14th, had some days unusually cool all over Hindostán. The greatest irregularities we find everywhere taking place in those months in which the rains begin; a delay of a week or two may appreciably alter the course of the month;

[1] Dove, "Nichtperiodische Veränderungen der Temperatur," Parts I to IV.

[2] Alterations gradual but infinitely slow, those of which we have reason to suppose that they have their origin in earlier geological periods, cannot be taken into consideration in the estimation of differences such as those detailed here.

[3] In higher latitudes it was found, that disturbances do not extend over very large surfaces, and depressions in one region we generally find compensated by an excess of temperature in a territory not very distant. When compared in reference to distance, disturbances in the tropics spread over a greater surface than those of temperate climates.

also the months of the cool season are more irregular than those of the hot season. Autumn here, as in all the northern hemisphere, has the least irregular variations; in Europe September is the month most constant; here October is still more so, September being still too near the end of the rains.

The more we recede from the equator—to the north or to the south—the greater in general non-periodical variations become; Assám in the east, as well as the Pănjáb in the north-west, are decidedly the provinces most variable amongst those given here. Unusual modifications, unless supported by positive observation and numerical data, have to be interpreted with precaution, exceptional phenomena of any kind being too easily overrated and analoga forgotten; also in the "Remarks" of my medical reports I had to balance many a note true in itself but produced with too much importance.

Phrases such as "the weather is quite unusual for the season," and their variations, are standing sentences but too often met with in written and printed meteorological correspondence in cases which, when examined, show but indifferent modifications in time or character, if any; but we must add, as its apology, generally coinciding with periods unusual to European residents. That the natives are as impatient cannot surprise us either, if we consider that even at home no modification a little exceptional can pass without being overrated.

VARIABILITY.

Variability may be understood in different manners, including the periodic variations, or limited to non-periodical modifications only.

In the first meaning we may perhaps form the most complete idea by the following consideration: If two curves of temperatures, &c., are drawn so as to include all the rises and falls for a given period (on the same system of co-ordinates and scale), their length in rectilinear measure may be compared as the most complete expression of the "total variability." In the concluding meteorological tableau I shall have occasion, by the use of my *Revolving Scale*, to employ such determinations to curves of temperature as well as to those of other meteorological phenomena; and various objects can be compared with each other, when the proportions of the co-ordinates are fixed.

Temperature in particular may be more easily analysed by using the method I

had formerly employed also in the "Alpine Researches;"[1] it is sufficient for this purpose to take the extremes, viz.:

A. *Absolute variability.* The difference between the coldest and the warmest mean of the month, year, &c.; the longer the period analysed, the greater is the probability of really approaching the greatest difference which ever may occur. In higher latitudes, especially for such comparisons, a considerable number of years is required, as here the differences are as great as irregular, and one year a very cold winter or very hot summer may considerably modify the result.

B. *Mean variability.* It can be deduced by taking the arithmetical mean of the differences of the monthly means of the single years from the general mean of the period analysed; the sign of the difference (whether too warm or too cold) remains unnoticed.

If, *e. gr.*, the mean of January is at Madrás for 10 years

$$\begin{array}{ll} 1851 = t_1 & \dots\quad .. \\ 1852 = t_2 & \dots\quad .. \\ 1853 = t_3 & 1860 = t_{10}, \end{array}$$

$$\text{the mean of } 1851 \text{ to } 1860 = T,$$

the deviations d for each year are

$$\begin{array}{ll} d_1 = T - t_1 & ..\quad ..\quad . \\ d_2 = T - t_2 & ..\quad ..\quad . \\ d_3 = T - t_3 & d_{10} = T - t_{10}, \end{array}$$

the mean variability D becoming

$$D = \frac{d_1 + d_2 + d_3 \dots + d_{10}}{10}.$$

In the tropics, here to be examined, the materials are not continued through periods long enough to deduce in general the *mean* variability; besides, the changes are so small, that even if we use the absolute extremes before us, we may expect

[1] Unters. über die phys. Geogr. der Alpen, Vol. II, pp. 373 to 381, from Dove, "Abhandlungen," Berlin Acad., 1838 and 1839, and Quetelet, "Sur les Variations périodiques et non-périodiques de la Température." Bull. Brux., XX, 6, 1853.

what we obtain to differ but very little from mean results; at all events the numbers obtained can be quite well compared for different stations. In the region of the trade winds the monthly means vary even still less than in the region of the monsoons.

In higher latitudes these values rapidly increase, and here we best see—much better than in the tropics, where climate is altogether so constant throughout—how different local conditions do affect the temperature. Variability increases when approaching the frigid zone, and the more when proceeding from the sea-shores towards the interior of continents up to a certain distance from the sea; but beyond this it diminishes again; it is greatest neither in a well-defined marine nor continental climate, but where one passes from one into the other.

For the tropics of Asia I selected, in the following tables, those of the stations best adapted for each of the respective regions: in order to facilitate the comparison I have limited myself for Madrás and Calcutta to a period not much longer than those I had to examine for the other stations.[1]

[1] As seen from the detailed tables given in the "groups," the years were not always complete in reference to the months; I therefore indicated also the sum total of the months I had within the respective periods of years.

CEYLON, AND SOUTHERN INDIA.

	Kolombo, Ceylon. Lat. N. 6° 56′·1; Long. E. Gr. 79° 49′·8 ⚐; Height (=) 18 ft. 69 months *in 6 years*, 1812 to 1855.				Madrás. Lat. N. 13° 4′·2; Long. E. Gr. 80° 13′·9 ♁; Height (=) 27 ft. 143 months *in 13 years*, 1841 to 1857.			
Month	Mean of the month	Hottest mean (a)	Coolest mean (b)	Vari-ability (a—b)	Mean of the month	Hottest mean (a)	Coolest mean (b)	Vari-ability (a—b)
January	78·7	79·4	77·8	1·6	76·4	77·6	74·8	2·8
February	79·5	80·4	78·3	2·1	78·3	79·6	75·4	4·2
March	81·2	82·4	80·2	2·2	81·8	83·1	80·2	2·9
April	82·4	84·3	81·0	3·3	85·8	86·6	84·7	1·9
May	81·8	83·8	79·2	4·6	87·1	90·3	85·0	5·3
June	81·3	81·8	80·3	1·5	87·7	90·4	85·5	4·9
July	80·7	81·8	79·6	2·2	86·4	88·2	84·8	3·4
August	80·5	80·9	79·9	1·0	85·1	87·0	82·5	4·5
September	80·3	81·5	79·5	2·0	84·4	86·3	82·4	3·9
October	79·1	79·7	78·4	1·3	81·7	83·8	79·8	4·0
November	78·8	80·8	78·2	2·6	78·7	80·8	77·8	3·0
December	78·1	79·8	77·1	2·7	76·7	77·7	75·6	2·1

BENGAL, AND HINDOSTÁN.

	Calcutta. Lat. N. 22° 33′·0; Long. E. Gr. 88° 20′·0 ♁; Height (=) 18 ft. 94 months *in 8 years*, 1851 to 1858.				Ágra. Lat. N. 27° 10′·2; Long. E. Gr. 78° 1′·7 ♁; Height 657 ft. 80 months *in 8 years*, 1850 to 1857.			
Month	Mean of the month	Hottest mean (a)	Coolest mean (b)	Vari-ability (a—b)	Mean of the month	Hottest mean (a)	Coolest mean (b)	Vari-ability (a—b)
January	67·4	68·6	66·4	2·2	57·5	63·0	55·1	7·9
February	73·1	76·8	71·0	5·8	66·4	68·0	63·3	4·7
March	80·7	82·5	78·7	3·8	76·0	81·7	72·7	9·0
April	84·9	86·3	82·3	4·0	85·5	90·5	80·9	9·6
May	86·9	90·1	85·0	4·1	94·8	96·7	92·0	4·7
June	85·2	86·9	83·3	3·6	93·9	96·3	88·7	7·6
July	83·1	84·1	82·2	1·9	86·0	92·5	81·3	11·2
August	83·2	84·5	82·0	2·5	85·3	89·4	81·3	8·1
September	83·4	85·0	82·3	2·7	84·0	88·1	81·8	3·6
October	81·4	83·5	80·5	3·0	78·1	81·2	78·3	2·9
November	74·5	75·2	73·0	2·2	69·2	72·7	66·0	6·7
December	67·6	68·6	66·7	1·9	60·2	62·4	58·8	3·6

PĂNJÁB.

	Ambála. Lat. N. 30° 21′·4; Long. E. Gr. 76° 48′·8 P; Height 1,026 ft. 76 months *in 7 years*, 1850 to 1856.				Lahór. Lat. N. 31° 31′·1; Long. E. Gr. 74° 14′·6 P; Height 839 ft. 59 months *in 6 years*, 1850 to 1856.			
Month	Mean of the month.	Hottest mean (a)	Coolest mean (b)	Variability (a—b)	Mean of the month	Hottest mean (a)	Coolest mean (b)	Variability (a—b)
January	54·5	57·8	50·2	7·6	52·3	57·8	47·3	10·5
February	61·0	65·1	54·9	10·2	60·7	66·4	54·0	12·4
March	69·9	76·5	65·0	11·5	68·3	78·1	65·1	13·0
April	78·4	83·3	71·2	12·1	78·6	80·8	76·1	(4·7)
May	86·5	91·6	80·7	10·9	87·1	89·9	82·6	7·3
June	91·1	94·8	85·6	9·2	92·2	96·7	89·5	7·2
July	85·8	93·7	83·7	10·0	87·6	89·8	85·1	(4·7)
August	85·7	87·4	82·4	5·0	86·4	89·6	82·5	7·1
September	84·3	87·4	81·0	6·4	85·7	86·6	83·8	2·8
October	75·0	81·5	70·9	10·6	77·0	81·1	73·7	7·4
November	63·2	68·0	59·6	8·4	66·4	72·8	63·6	9·2
December	56·2	61·7	54·2	7·5	57·7	66·0	54·2	11·8

MOUNTAINS OF INDIA

	Nílgiris: Utakamánd. Lat. N. 11° 23′·7; Long. E. Gr. 76° 43′·2; Height 7,490 ft. 99 months *in 10 years*, 1826 to 1856.				Khássia Hills: Cherrapúnji. Lat. N. 25° 14′·2; Long. E. Gr. 91° 40′·5; Height 4,125 ft. 50 months *in 5 years*, 1851 to 1855.			
Month.	Mean of the month.	Hottest mean (a)	Coolest mean (b)	Variability (a—b)	Mean of the month	Hottest mean (a)	Coolest mean (b)	Variability (a—b)
January	51·5	53·6	49·7	3·9	57·8	53·5	49·1	4·4
February	52·8	54·5	51·5	3·0	54·7	56·2	53·4	2·8
March	57·3	60·0	53·0	7·0	61·5	63·3	60·0	3·3
April	60·1	63·0	57·2	5·8	63·5	65·4	62·7	2·7
May	60·8	64·5	55·3	9·2	67·2	69·2	66·1	3·1
June	57·9	62·5	53·9	8·6	67·1	68·4	66·2	2·2
July	55·8	58·0	54·2	3·8	68·5	70·3	64·4	5·9
August	56·1	59·0	52·9	6·1	68·1	70·1	65·4	4·7
September	56·4	57·5	54·7	2·8	67·8	70·0	64·6	5·4
October	55·9	58·0	53·1	4·9	65·8	66·7	64·7	2·0
November	53·9	56·0	51·4	4·6	58·8	61·5	56·4	5·1
December	51·9	53·1	49·4	3·7	55·1	56·3	54·0	(2·3)

HIMÁLAYA.

Month.	Kathmándu. Lat. N. 27° 42'·1; Long. E. Gr. 85° 12'·2 ♃; Height 4,354 ft. 118 months *in 13 years*, 1835 to 1857.				Símla. Lat. N. 31° 6'·2; Long. E. Gr. 77° 9'·4 ♁; Height 7,057 ft. 52 months *in 6 years*, 1850 to 1856.			
	Mean of the month.	Hottest mean (a)	Coolest mean (b)	Variability (a—b)	Mean of the month	Hottest mean (a)	Coolest mean (b)	Variability (a—b)
January	45·4	50·0	40·0	10·0	45·0	50·3	39·7	10·6
February	50·3	53·6	43·0	10·6	50·2	54·0	43·1	10·9
March	56·6	60·7	53·2	7·5	53·5	56·0	53·4	2·6
April	61·6	65·1	57·1	8·0	58·9	61·2	56·0	5·2
May	67·5	69·6	63·9	5·7	65·9	69·0	61·8	7·2
June	72·1	74·4	68·7	7·5	70·1	72·8	67·2	5·6
July	73·1	74·3	71·5	2·8	66·0	66·7	65·6	1·1
August	73·1	74·9	71·5	3·4	64·2	66·0	63·0	3·0
September	70·7	72·3	69·3	3·0	63·8	65·7	61·2	4·5
October	64·7	71·0	60·8	10·2	59·3	60·7	56·5	(4·2)
November	55·6	59·5	49·8	9·7	52·0	55·7	44·9	10·8
December	49·5	54·8	43·6	11·2	45·7	48·2	43·7	6·5

In the *Indian Archipelago* and along the *Southern Coasts* the deviations are so small that they do not even allow of one's recognising a regular connection between the different seasons. The months in which rains may be more or less frequent show a tendency also to vary more in reference to the mean of their monthly temperature. In *Calcutta* already the regular rain of July marks this month at once as the most constant one; in *Ágra and the North-west Provinces* only in August, September, and October such a depression of the variability follows the rainy season.

In the cool season the variability is throughout less than in the hot season.

In the Pănjáb the tropical character has passed already into that of an excessive or continental climate, and here we find throughout the year values approaching those we meet with in Southern Europe, though not quite so variable. As in Europe, too, where summer rains prevail, the months following next, August and September, show particularly little variation. For Ambála as well as for Lahór the periods compared are somewhat too short, but both combined show at the same time the general character quite well, if we notice that January and December appear to be insufficient for Ambála, April and July for Lahór. Here already, as in the whole of Central Europe, the winter months are about those most variable; but the other seasons show no analogy.

Our month of April, proverbially quoted for inconstancy, is chiefly known as such by the circumstance that in this period the atmospheric precipitation oscillates between rain and snow, thus "showing" the frequent difference in "temperature of atmospheric precipitation," which in summer very often amounts to much more, if we compare a warm local thunder-storm with a general rain of some days' duration; but then to the observer in general the difference does not become so apparent. As will be seen from the table for Europe, the monthly mean for April varies much less in our latitudes than does that of the winter months.

In the territories I examined a similar apparent increase remained limited to great elevations. In the mountainous parts of the south the variability is already decidedly greater than along the coasts to the east or west; here, as in Kolombo and in Madrás, May shows the greatest variation.—In the Khássia Hills, the part of the globe where the rain is the most heavy known till now, the setting in of the violent rains in June makes the mean decidedly more constant; but in July and August, notwith-

standing the amount of precipitation being still so enormous,[1] the variability differs but little from that of the other months.

For the Himálaya Kathmándu, as well as Símla, shows a decided increase of constancy from June to October; the cool season and the beginning of the rainy season are about the same as in the Pănjáb. Here, as in the Alps of Europe, elevation from a certain height has so decided an influence in reducing the daily range; even on *single days* the formation of clouds—fogs for the observer when within them—makes the temperature less variable than we might at first expect. But the variability of the monthly *means* seems not to be appreciably altered.

For the eastern parts of the Himálaya I can but allude to the short period I procured myself for Darjíling; here, from May to September, as long as the heavy rains last and till the clearing-up of the sky in October begins, the variability appears not to exceed that of any of the islands of the Indian archipelago; from October to April it seems frequently to reach 5° Fahr.

For the Tibetan and Mongolian territories to the north—where no rainy season breaks the power of the estival sun, only some cumuli periodically calling to one's mind the streaming clouds of the neighbouring Himálayan zone, I can but add as an estimate that the comparison of the data of other travellers with our own for Tíbet allow one to expect very little variability for summer; rather more for winter, when more or less precipitation takes place in the form of snow and sleet. On the northern side of the Kuenlúen, when crossing it even in summer and autumn, we found a much greater variety of climate in the time we passed there than during all our repeated visits to Tíbet.

For connecting the data here analysed with what we know better still from regions nearer home, I add the means of absolute variability as deduced from European observatories.

[1] The average quantity is more than 600 inches, of which about 250 fall in June, 150 in July, 100 in August.

EUROPE.

General Result of absolute Variability.

Month	Italy	The Alps	Germany	Northern Europe
January	12·3	20·0	21·2	23·7
February	12·1	16·0	17·6	23·1
March	12·0	15·0	13·4	18·4
April	10·5	14·5	10·7	15·7
May	10·9	11·8	12·3	13·5
June	11·6	11·4	8·9	13·0
July	8·3	11·2	10·6	12·5
August	10·0	12·1	11·3	13·1
September	9·6	10·5	7·7	12·0
October	9·6	11·5	10·0	15·2
November	10·7	13·5	11·8	16·7
December	11·9	20·5	21·9	21·7

VESTIGES OF PERMANENT ALTERATION OF OUR CLIMATE.

As far as at present our meteorological materials go back, we cannot trace any permanent change of climate; the oldest dates of Paris, Mannheim, London, Geneva, only show that a sufficient number of years present a mean which as far as we can get in our comparison must be considered as identical with that of any other period of the same number of years. But this does not exclude the probability of changes of temperature having gradually taken place—very small, but not quite without analogy with those connected with the phenomena of earlier geological periods.

I chiefly allude to those connected with changes in the form of the surface of the earth, such as the deposition of deltas, the erosion (excavation of river beds), and the drainage in general, together with the drying up of lakes and swamps in particular.

The latter perhaps deserves our special attention as the one of the most general influence by its extent and frequency. Wherever we examine the topographical modifications, particularly in larger mountain systems—in the Alps, in the Cordilleras, in the Himálaya, and in Tíbet—we find lacustrine basins now completely drained by the gradual erosion of the outlet; the number of years necessary for producing this result we best leave undefined, reaching, as it does, back far beyond any history; but nevertheless it is so decidedly in its form the result of gradual, not sudden, action, that it cannot be misunderstood. In the Eastern Himálaya, where now all lakes have disappeared—one or two, as that of Nainitál, excepted—we see in the centre of Nepál the large basin occupied by its capital Kathmándu filled up with the most decided lacustrine deposits, larger than any analogous form in our European Alps. Smaller basins, equally well-defined by their forms as being early reservoirs of fresh water, I might name in great number, from Narigún,[1] in Bhután, in the east, to the Jhilum basin in the west; but I should interrupt too much the considerations forming the special object of this volume, were I to enter here already into all the details I shall have occasion to give in the geological volume.

[1] On my way up to Narigún alone I passed three analogous but smaller lake basins, now drained.

The central part of Kashmír, drained by the Jhilum, with the environs of the capital Srinager, we see in Plate 18 of the Atlas. It is a country as level as any lacustrine basins now drained can be expected to be. At present only at two spots of it have remained fresh-water lakes, the Chunár and Vúler lakes; the former is so shallow that a ten-feet cutting deeper of the Jhílum would have been sufficient to make it disappear too. The length of the Chunár lake is about seven miles, that of the Vúlar lake eleven to twelve; but the entire basin—say only from Islamabád to the beginning of the rapids at Baramúlla—has a length of more than seventy miles, and from thirty to forty miles in breadth. It is evident that such a sheet of water, not less than a great alteration in the extent of forests, must have affected climate, by evaporation, and, in immediate connection, by alterations of temperature; the more if we consider that similar alterations are not isolated, but are met with all around, in Kishtvár, Vardván, Súru, Zánkhar, &c.[1]

And indeed for Tíbet the very details of its salt-lakes can be considered as a positive proof that the evaporation, the relative moisture, has been altered; if so, temperature not less than all the delicate modification combined into climate must follow. In Tíbet too we find everywhere large remains of lakes now drained, though not so completely as in the Himálaya, erosion having not gone on quite so far; some lakes have remained. But whilst many remains of animal and vegetable life show

[1] It would lead me too far to enter here into a detailed consideration of the geological causes; what I allude to I only do in connection with the interesting report recently made by Capt. Austen, "The glaciers of **Bálti**," in the January meeting of the London Geographical Soc. (the principal Mustágh glacier is that represented already in part **I.**, Plate 10 of our Atlas). The question was raised on this occasion by Dr. Falconer, and examined later by Dr. Jukes (Reader, Febr. 6th), whether the "want of lakes in the Himálaya should be connected with the modification that the basins had not been filled out by solid ice, which should have protected them a considerable time against the deposit of detritus, thus leaving such empty depressions and causing later the existence of lakes in the Alpine territory of Europe."—I think it sufficient here to limit myself to direct the attention to the fact, that as Mr. Jukes already expected, a great number of lacustrine basins now empty are met with everywhere in High-Asia, and that the lakes have existed, covering a surface in proportion at least as large as in any other mountainous system; but that the power of the erosion has drained them nearly everywhere in the Himálaya—a fact as remarkable as the absence of waterfalls, equally produced by the same cause, viz. by the circumstance that the powerful precipitation increased in its action by being concentrated into the space of a few months has had the effect, that in the principal river beds we find numerous variations of inclination and velocity, but all the steps where still the trace of waterfall is as distinct as anywhere it can be, are reduced to rapids. Even the junctions of lateral rivers where, in the Alps, waterfalls are the last to disappear, are here nearly invariably reduced to an increase of inclination, frequently very small too.

The first details about erosion, the absence of lakes and waterfalls, we gave in our official "Reports of the Magnetic Survey," reprinted in the Journal of the As. Soc. Bengal, 1855 to 1858; also at the British Association, at Dublin and Oxford, we had occasion to communicate some of the general results.

them to have been fresh-water lakes, we find them now gradually dried up, evaporation no longer balancing the dryness of the atmosphere; and their water is unequally condensed, the degree of condensation being modified locally by topographical conditions. But what is common to all of them, is that they have become concentrated, more or less, like the water in a steamer's boiler, and that they are not connected with any rock-salt *in situ*, as had been formerly expected. Equally important it is that the strata surrounding their shores and marking the former level, everywhere have remained horizontal, showing that it has been effected in the last period only, and probably at a rate not much more rapid than the erosion of the rivers is continued in the Himálaya.[1]

If I have added here, before passing to the details of the meteorological stations, some considerations of a nature much more general, I have done so because these topographical modifications, of a form so rare and at the same time so distinct and plain, appeared to me not less connected with meteorology than with geography.

Glaciers too, and the questions of glacial periods, have to be analysed in combination with the traces of alteration of climate; the isothermal conditions of the Himálaya and Tíbet, when analysed in a later part of this work, will present new details in intimate connection with it.

[1] The salt-lakes now contained in my views are the following: Tso Gam and Tso Mitbál, Plate 6; Kiúk Kiöl, Plate 13; Tsomoríri, Plate 24; and Tsomognalarí, or Pangkóng, Plate 25.

VIII. DECREASE OF TEMPERATURE WITH HEIGHT IN THE TROPICS.

Decrease between various Stations. Influence of the form of the ground.

Decrease in the free Air. Use of the barometrical formulæ for its determination. Example on the Parisnáth Hill

Decrease next to the Surface. At sea on deck and on the foretop. Over tropical soil.

Comparison of Indian Heights with European Climate.

DECREASE BETWEEN VARIOUS STATIONS.

The influence of height is an element of general importance for all meteorological phenomena; in reference to temperature its effect is to produce a decrease—the temporary accumulation of cold air in valleys excepted—and this decrease is very variable with the form of the ground and with the seasons. For the Indian territories in particular it is of practical importance for the selection of stations, settlements, and sanitaria; in the analysis of the meteorological materials it must guide us in comparing the different parts of India, independently of the accidental height of the observer's residence, and for drawing finally the general isothermal lines.

Slight undulations of the ground, as well as moderate elevations of a very great surface,[1] cause but little decrease; it becomes the more rapid the more the form of the higher point approaches an isolated position in the free air. In mountain systems of great extent, such already as in the Alps, and much more still in those of High Asia, to the north of India, the decrease becomes materially modified by the topographical conditions. (These shall be analysed later, in special connection with the various parts of High-Asia.)

[1] This becomes very evident, too, when we come to compare the "subterraneous isothermal lines," showing the temperature of those strata of the soil which must be considered as participating still in the variation of the external conditions.

For the tropical parts of the territories examined, where the difference of height in most cases is not very great, it becomes very important to select stations for the comparison which present a sufficient variation of height.

For Bengál and Assám, Silhét and Gohátti could be connected by calculation with Cherrapúnji, Parisnáth with Ranigânj; the latter group perfectly corroborates the rapid decrease when isolated peaks are compared with plains, whilst a general mean elevation round the upper stations causes a less rapid change of temperature with height; in this respect such places as Parisnáth would have a decided advantage as sanitary stations, did not the limited space and the steepness of the slopes present some disadvantages.

For the Dékhan and Central India, Púna, Purandâr, and French Rocks could be compared with the coast of the Kónkan and the Karnátik; for the south I had three stations in the Nílgiris and one in Ceylon for which the decrease could be calculated from the shores of the Indian Ocean.

The following table shows the results I had obtained for the year and the seasons.[1]

A. *Assám and Bengál.*

Places of observation.	Height above the level of the sea.	Height in feet = decrease of 1° Fahr.				
		Year.	Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.
ASSÁM.	Engl. feet.					
Gohátti	134	300	340	300	270	300
Cherrapúnji	4,125					
BENGÁL.						
Silhét	25	300	300	300	290	310
Cherrapúnji	4,125					
Ranigânj	319	250	250	248	256	246
Parisnáth	4,469					

[1] In my abstract memorandum presented to the Royal Society of London I had limited myself to table B and C.

B. *Dékhan and Central India.*

Places of observation.	Height above the level of the sea.	Height in feet = decrease of 1° Fahr.				
		Year.	Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.
	Engl. feet.					
Púna	1,784	410	370	360	310	595
Purandár.	3,974	435	450	660	230	390
French Rocks . . .	2,620	750	900	1,200	340	600

C. *Nílgiris and Ceylon.*

Places of observation.	Height above the level of the sea.	Height in feet = decrease of 1° Fahr.				
		Year.	Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.
Nílgiris.	Engl. feet.					
Átare Mállē	4,500	270	310	260	220	290
Utakamánd.	7,490	280	300	270	260	290
Dodabétta	8,640	310	350	310	265	300
Ceylon.						
Nurélia	6,218	280	290	280	270	290

Many more combinations might be formed from the stations of the various groups, were it not very important to select localities sufficiently differing in level without being too distant from each other.

For the Dékhan and Central India we see that the decrease is very slow; stations varying only 100 to 150 feet in height we frequently find not yet to show any effect of it when looking into the detailed registers; for the Alps, I formerly obtained 320 Engl. feet for 1° Fahr.[1] As the principal cause of the decrease being not more

[1] "Physical Geography of the Alps," Vol. II., p. 584. The numbers I have given there are 540 French feet for 1° Centigr.

rapid, we may consider, I think, the circumstance that the elevation, though not very considerable, extends with great uniformity over a large surface.

In the first and third group the values differ less from those in the Alps; for all the Indian stations it is characteristic that the rainy season shows by far the most rapid decrease. The principal cause of it is that at a certain elevation above the general surface more heat than lower down becomes latent by the frequent dissolving of the clouds when sinking so far.[1]

In order to show *simultaneously* the variations of the decrease with the locality and the seasons, I have drawn in the Atlas three topographical profiles,[2] and have indicated for each of the single seasons the difference of the respective decrease from its annual mean value by drawing a dotted line in connexion with the topographical outline. Assám and Bengál vary so little in the different seasons, that for them no special diagram had to be drawn. The dotted line in these surfaces shows the contour which the topographical section ought to have for the actual temperature of the season, supposing the value of the decrease had remained the same throughout the year; if, therefore, the decrease in the season is too slow, the new ideal position of the station will be below the real topographical outline, on account of the station having a temperature as if it were in a less elevated situation; if, *vice versâ*, the decrease is more rapid than the annual mean, as we see it particularly to be the case in the rainy season, the dotted line will show, for the same reason, a profile which is higher than the topographical contour. For Ceylon I further added the point of its highest peak, Péduru tálla gálle, 8,305 feet, for the sake of completing the general topographical profile of the island, though I had no higher station for its mountainous regions than Nurélia.

DECREASE IN THE FREE AIR.

What we can deduce from the comparison of stations of different elevation might be interpreted wrongly if considered as the decrease of temperature in the free air. The various bold explorations in balloon ascents have sufficiently shown how much this varies with the atmospheric conditions, chiefly with the direction of the wind,

[1] See "Moisture of the atmosphere and temperature of the rain" in Vol. V.

[2] In Plate III. of the Illustrations of Indian Meteorology, "Isothermal lines of the seasons."

and the accumulation of clouds. Also the barometrical observations at places the height of which is defined independently of the barometer can be used for calculating (by inverting the formula[1]) the temperature which must be introduced for obtaining the correct height; this value represents at the same time the temperature in the *free air* at half the elevation above the lower station. Before our departure already I had occasion to try this method in the Alps; also the results I obtained for India as well as for the Himálaya were nearly the same. The daily variation is much smaller than at the places of observation near the surface, and where the difference of height is very great, the maximum of the day is sensibly later in the free air than at either station; at heights of 3000 to 4000 feet above the ground the daily variation has the chance of disappearing nearly entirely.

As an example for Indian heights I may best select two of the days passed in April 1856, by Dr. von Liebig, on Parisnáth Hill,[2] 4,469 feet; the first column contains the mean of the thermometer readings at the upper and the lower stations, the second column is the result he obtained for the free air at half the elevation by the formula I also had used for the Alps; my view of Parisnáth, Plate 19 of the Atlas, showing the surrounding plains, allows one at the same time to compare the topographical conditions.

Calcutta—Parisnáth Observations.

April 1856.

A. Means of temperature in the shade, deduced from the observations of the *thermometers*, 4 feet above the ground.

B. Means of temperature for the free air, at 2,230 Engl. feet above the sea, deduced from the barometrical observations.

[1] "Physical Geography," Vol. II., pp. 409—422.

[2] "Discussion of some Meteorological Observations made on Parisnáth Hill," by Dr. G. von Liebig. Journ. As Soc. Beng., 1857, pp. 1—45.—Some minor oscillations not perfectly contemporaneous with the changes of the barometer and thermometer are eliminated already from these numbers; altogether, some of these corrections exceed $\frac{1}{2}$° C. The degrees are Centigrade in the original.

	April 1st.		April 3rd.	
Hours.	A.	B.	A.	B.
6^h A.M.	74·5	78·1	74·5	...
7 "	75·0	77·5	...	...
8 "	77·4	78·6	77·2	79·2
9 "	79·0	80·1	80·6	79·5
10 "	81·9	81·1	83·8	80·1
11 "	84·0	82·6	86·2	80·8
Noon	86·2	83·3	87·6	81·7
1^h P.M.	88·3	84·6	89·8	82·6
2 "	90·1	84·0	91·4	83·1
3 "	89·6	84·2	91·4	82·4
4 "	89·1	82·6	90·5	81·7
5 "	87·6	...	88·2	81·3
6 "	84·2	...	84·9	81·1
7 "	82·4	...	83·5	80·8
8 "	81·1	...	81·7	80·6
9 "	...	...	80·4	80·1
10 "	79·2	...	80·4	80·1

DECREASE NEXT TO THE SURFACE.

The decrease of temperature next *to the surface* is generally very rapid; we had tested it in connection with various other observations during our voyages by putting up two pairs of instruments, dry and wet bulb, one on deck in a position perfectly accessible to the wind before it had swept over the deck; the other I read on the foretop.

The following results are the average of our observations in the Red Sea from Suez to Aden, October, 1854, and in the Bay of Bengál between Madrás and Calcutta, March, 1855. In the first series the height of the deck above the sea was 16 feet, that of the foretop above deck 49 feet; in the second series the deck was 22 feet above the sea, the foretop 55 feet above the deck. The position of the sails enabled us to select also on the foretop a place where the thermometers in the shade were perfectly well protected against insolation as well as glare.

A. *Red Sea*, from Suez to Aden, October 8-19, 1854.

	Deck.	Foretop.	Diff.
5^h 30^m A.M.	78·1	77·9	0·2
10^h "	79·9	79·2	0·7
2^h 30^m P.M.	81·6	79·1	2·5
6^h "	80·4	77·9	2·5

From the observations at Aden (see Group X. of the Stations) we see that whilst at sea the mean of October is 79 to 80, it is 83·3 on land; in June, the hottest month, the mean at sea and on land rises still 2 to $2\frac{1}{2}$° Fahr. In order to complete the various forms under which such thermical conditions are felt I may add, besides some observations we made on the sea-water, also a few words about some of the conditions on board the steamer.

October 13, in Lat. N. 14° 36′, Long. E. Greenw. 42° 30′, from 4^h to 5^h P.M., the temperature in the dining room of the P. and O. Comp. steamer "Oriental" rose to 86·1; the iced water—a great luxury nevertheless,—was 72·5; claret 75 to 79: champaign we had this day came up with the temperature of the store room, 82·4. At 6^h 15^m P.M., we made, as every evening, the last observations on the sea-water before the darkness set in, here so rapidly following sunset. The temperature of the Red Sea on the surface was 88°·6 Fahr.; water brought up by a cylinder with conical valves from a depth of 246 feet was 86·0.[1]

B. *Bay of Bengál*, from Madrás to Calcutta, March 1st to 5th, 1855.

	Deck.	Foretop.	Diff.
5^h 30^m A.M.	75·7	75·6	0·1
2^h P.M.	79·7	77·0	2·7
6^h "	75·7	75·5	0·2 [2]

We see that some 50 feet produce a decrease for the mean of the day (this differing on sea very little from mean of SR. and 2^h P.M.) about twice as great as that produced by 300 to 400 feet of elevation, when stations both with their instruments at the ordinary distance from the ground are compared, as in the preceding tables.

Observations I had occasion to make on the gallery of Ochterlony column at Calcutta in the hot season, end of March 1855, showed a decrease of 1° Fahr. within

[1] I may call attention to the remarkable fact that sea-water is very much warmer than the temperature of the air; even at this depth it still exceeds in October by ½° Fahr. the mean of the air in June, the hottest month, and by 6° Fahr. that of the year. (The specific gravity, reduced to $63\frac{1}{2}$° Fahr., was on the surface 1·0307, at a depth of 246 feet 1·0311.) Our first official Report (reprinted in the Journal Asiat. Soc. of Bengál, 1855), contains the details of our observations on our way out; a general comparison of the temperature and specific gravity will be given in comparison with the hydrographical observations on lakes, rivers, and springs.

[2] The very small decrease in the evening appeared to coincide with the setting in of the sea-breeze.

50 feet; sometimes the decrease was more rapid still, though it naturally varied considerably on different days, particularly with the state of the sky.[1]

COMPARISON WITH EUROPEAN CLIMATE.

No height in India is considerable enough to present a climate as cool as the European settlers are accustomed to from England; whilst, as we shall see, the highest peaks of the Himálaya reach up into elevations where their temperature has every chance of being as cold as any of our Alpine peaks.

For facilitating the comparison with European climate Mr. GLAISHER, in his interesting report upon the meteorology of India, in relation to the health of the troops there stationed,[2] has calculated three tables, showing the height to which we should have to rise to meet Greenwich temperature.

The Greenwich values are put together in the following table; they are based upon the observations from 1841 to 1860.

Temperature of the Air in the shade.
Greenwich temperature.

	Mean Temperature.	Mean Maximum.	Mean Minimum.	Absolute Extremes. Maximum.	Absolute Extremes. Minimum.
January	38·3	43·2	33·7	57·0	4·0
February	38·4	44·7	33·2	62·3	7·7
March	41·7	50·0	35·3	71·5	13·1
April	46·3	56·8	38·6	79·0	25·3
May	52·8	64·4	44·2	86·2	28·3
June	59·2	71·2	50·2	94·5	36·2
July	61·9	73·8	53·2	93·3	38·9
August	61·3	72·8	53·4	92·0	40·0
September	56·9	67·4	48·9	86·4	32·0
October	50·2	58·3	43·7	81·0	26·5
November	43·3	49·3	37·7	66·3	19·4
December	40·1	45·0	35·5	62·8	8·0
Year	49·2	58·0	42·3	77·6	23·2

[1] The observations in the free atmosphere made in the various balloon ascents show great irregularities still up to considerable heights. As one of the most remarkable I quote the last ascent of Mr. GLAISHER in 1863 (from "Les Mondes," p. 636). In June he met with snow and crystals of ice at 16,000 feet, these clouds having a vertical thickness of 5,200 feet.

[2] "Parliamentary Sanitary Reports," Vol. I., pp. 701—943.

The Indian tables are calculated for every two degrees of latitude; it is evident from a glance at the isothermal lines of the seasons that only for the months of the cool season the deviations from these "means of latitude" are not very great, since in this season, as with us in Europe, the average direction of the isothermal lines is an east-westerly one; in the other seasons the distance from the sea-shore so materially effects altogether the course of the isothermal lines that this modification must be taken first of all into consideration, if an estimate referred to a particular station should be made. As I explained above, these values cannot be understood as being the temperature of the free atmosphere, but they are an estimate of the height at which a mountain system (for instance, as Dodabetta Peak, 8,640 feet; the Nílgiris; Péduru tálle gálle Peak, 8,305 feet, in Ceylon), would have the respective temperature close to the surface of the ground, viz. under conditions analogous to those at the stations made the basis for calculating these tables.

The numbers given here refer especially to Indian stations, the northern regions of these tables being those of the Pănjáb, not the territories to the north of the Eastern Himálaya.

For the special analysis of the different data from the Himálaya, Tibet, and Turkistán, which is to follow the groups of the tropical regions, it was very important that the decrease of temperature with height in the Himálaya, the Karakorúm, and Kuenlúen had not to be *calculated* in connection with the construction of the isothermal maps: as I had direct data for the beginning of the isothermal lines along the western and the eastern margin of these mountainous regions, the form of the dotted lines which I now have drawn across them could be obtained directly by uniting the terminal points. This circumstance is very valuable, too, when I come later to examine the influence which is exercised by the topographical formation (including vast plateaux, ridges, and isolated lofty peaks), and by the extent of the snowy regions, upon the alterations of the decrease of temperature with height.

Means: Height of temperature = Greenwich, at different parallels of latitude.

Months.	15° and south of it	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
January	12,100	11,200	10,500	9,900	9,300	8,600	8,000	7,300	6,700	6,100	5,400
February	12,200	11,000	10,400	10,100	10,100	9,800	9,200	8,600	8,300	7,700	7,500
March	12,400	11,800	11,800	11,500	11,200	10,900	10,600	10,300	10,300	9,600	9,300
April	11,700	11,100	11,100	11,100	11,700	11,700	11,700	11,700	11,700	11,700	11,700
May	10,200	9,900	10,200	11,100	10,800	10,800	11,100	11,400	11,700	12,000	12,000
June	7,400	7,100	7,400	7,600	8,200	8,500	8,500	8,700	9,500	9,600	9,800
July	6,100	6,700	7,000	7,300	7,000	7,000	7,000	7,300	7,900	8,200	8,200
August	6,300	5,700	5,700	6,300	6,600	6,900	6,900	6,900	7,400	7,400	7,700
September	7,500	6,600	7,200	7,200	7,800	7,800	8,100	8,100	8,400	8,100	8,400
October	9,600	9,300	9,300	9,000	9,300	9,000	9,000	9,000	9,000	8,700	8,400
November	11,600	11,200	11,200	10,900	9,600	9,300	9,000	8,700	8,700	8,300	8,000
December	11,300	10,700	10,100	9,400	8,200	7,600	7,000	6,400	6,100	5,200	4,600
Year	9,900	9,400	9,300	9,300	9,200	9,000	8,800	8,700	8,800	8,600	8,400

Mean Maxima: Height of temperature = Greenwich, at different parallels of latitude.

Months.	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
January	11,000	10,400	10,100	9,500	9,000	8,700	8,200	8,000	7,500	7,300
February	10,200	9,700	9,400	8,700	8,200	8,000	7,600	7,400	7,200	7,000
March	9,000	8,800	8,600	8,500	8,300	8,100	8,100	8,000	7,800	7,800
April	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,400	7,400	7,400
May	6,400	6,500	6,500	6,700	6,700	6,800	6,800	6,900	6,900	7,000
June	4,800	5,000	5,000	5,200	5,400	5,600	5,600	5,800	6,000	6,200
July	3,600	3,900	3,900	3,900	4,100	4,400	4,400	4,600	4,800	5,000
August	3,900	4,100	4,100	4,500	4,500	4,500	4,500	4,800	5,000	5,300
September	5,600	5,600	5,800	6,100	6,100	6,300	6,300	6,300	6,600	6,600
October	7,500	7,700	7,700	7,700	7,700	7,700	7,700	8,000	8,000	8,000
November	10,300	10,100	9,800	9,300	9,100	8,800	8,800	8,600	8,600	8,300
December	14,000	13,400	12,700	11,400	10,600	9,400	8,600	7,800	7,000	5,900
Means	7,800	7,700	7,600	7,400	7,200	7,100	7,000	7,000	6,900	6,800

Mean Minima: Height of temperature = Greenwich, at different parallels of latitude.

Months.	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
January	17,000	15,500	14,000	12,500	11,000	9,500	8,500	7,000	5,600	4,200
February	12,200	11,500	11,000	10,700	10,000	9,200	8,600	7,600	7,000	6,400
March	13,100	12,900	12,200	11,600	11,000	10,400	9,800	9,200	8,500	7,900
April	10,800	10,600	10,300	10,000	9,800	9,600	9,300	8,800	8,600	8,400
May	8,500	8,500	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300
June	8,400	8,400	8,400	8,700	8,700	8,700	8,700	8,700	8,700	8,700
July	8,000	8,000	8,000	8,300	8,300	8,300	8,300	8,300	8,300	8,300
August	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300
September	8,600	8,800	8,800	8,800	8,800	8,800	8,800	8,800	8,800	8,800
October	10,700	10,300	10,000	9,700	8,900	9,000	8,700	8,300	8,000	7,300
November	13,600	12,800	12,000	10,800	10,000	9,600	8,400	7,600	6,800	6,000
December	13,400	12,800	11,400	10,600	9,800	8,200	7,800	6,600	5,800	5,000
Means	11,000	10,700	10,200	9,900	9,500	9,000	8,600	8,100	7,700	7,300

IX. THE PROBABLE CHANGES OF THE WEATHER.

Rules for weather.—Telegraphic communications used in Europe.—Favourable conditions to combinations in the tropics.—Meteorological offices.

The considerable number of stations all over India, together with its telegraph lines, allows also to think of a practical question in addition to the scientific researches: these, however, here, as in every branch of natural philosophy, must remain the principal object even for the very purpose of occasional useful application. Now already many of the general laws are sufficiently known and the materials are complete enough to allow inductions as to the probable changes of the weather, and for India especially about the beginning and end of the seasons.

There are rules of ancient date in Europe as well as in Asia, not unfrequently coherent with remnants of earliest paganism, for connecting certain phenomena with the weather, an object of so great and varied importance. Till recently all that could be done — credulous deceptions and personal charlatanism excepted — was limited to the vague date of "*popular experience;*" as series of such researches I can quote Dr. EISENLOHER's very interesting book[1] on the rules for the weather, where, however, his analysis in general did not turn out in favour of these rules; most of them he found arbitrary, many even decidedly wrong, others again of very unexpected boldness were found correct.[2]

[1] EISENLOHER, "Untersuchungen über die Zuverlässigkeit und den Werth der gebräuchlichen Wetterregeln." Karlsruhe, 1847. They are based upon 54 years of observation at Karlsruhe.

[2] Amongst the best were those predicting the changes of weather from that in the direction of wind, and, indirectly therefore also combinations made with the phases of the moon.

In connection with the detailed materials of positive observation which can be examined in many parts of Europe for half a century, another system has already been repeatedly tried, by combining them so as to allow one to judge for a year or two about the changes to be expected. But this too proved a failure. I particularly allude to the very positive predictions, by Mathieu de la Drôme, in the periodicals and almanachs of France. An examination of his predictions for 1863 has been published by Leverrier, the Director of the Paris Observatory, in the "Moniteur;" the results Leverrier obtains by the examination of the very same documents, the general observations continued since Saussure's beginning in 1796, are quite unsatisfactory as to such predictions. The weather of the year now passed has sufficiently proved it in all instances where a critical decision could be expected, whilst in many other cases the coincidence cannot surprise, if we keep in mind that the prediction such as stormy weather coinciding with the equinoxial period has in itself nothing surprising. At the same time, however, the care must be fully acknowledged which Mathieu and Leverrier have taken to test every combination which might have been supposed to have any connection with the weather to come.

The progress of modern meteorology has shown repeatedly that irregularities in many instances can be explained, when they are passed, from the registers we possess; and, what is equally important, it results that the causes are not so distant in time and space as at first might be expected, but distant enough not to be at the time in sufficient quantity for general conclusions.

Within more narrow limits, however, the use of the *telegraph* recently has proved itself of quite unexpected importance; it allows to know all around us—and the radius of this circle is rapidly increasing every year—those conditions of temperature, pressure, moisture, currents of the air, and state of the sky, which at once must appear the most important to form an estimate of the alteration to be expected within the next time; and, indeed, even in Europe, where its situation within a region of so variable a climate the difficulty of such combinations is materially increased, already now the results obtained are of great scientific and practical value.

Signals for storms by optical telegraphs had been used already for some time in America, but limited to this use only they could not define with sufficient accuracy the origin or the direction of the storms. Only when, on the proposal of the British Association of Science for 1859, the detailed signals of Admiral

FITZROY[1] were spread by numerous official establishments, the beneficial results at once became apparent.

The questions in reference to the phenomena along the sea-shores, especially in reference to rain, and to the outbreak and progress of storms, are very different ones for India from what they are for Europe. If, nevertheless, I add here some of the principal rules for Western Europe, I do so since, as they refer to the climate we best know, their interpretation is at the same time an assistance in finding out the leading rules for other climates. Such rules are with us:

If the barometer has its average height or rises whilst the thermometer sinks and the moisture of the atmosphere decreases, northerly wind or a decrease of wind and rain is to be expected.

If the barometer sinks whilst the thermometer rises and the temperature increases, southerly winds and rain are to be expected.

Exceptions may take place if northerly wind and rain, perhaps with lightning, are to be expected, for then the barometer only rises in consequence of the change of the wind, as well as occasionally it also may be found rising with southerly winds if dry.

If the barometer has been below its average the rise indicates a decrease of moisture and wind, also a northerly change of the wind. If it has been very low the first rapid rise is generally followed by heavy northerly winds. A gradual rise indicates the clearing up of the weather, if at the same time the thermometer sinks; but if this is not the case, if the temperature remains warm, the chance is that wind from the south sets in again and a prolongation of the bad weather is to be expected.

[1] Admiral FITZROY, "Barometer and Weather Guide," London, 1861, 4th edition.

His researches were followed by numerous detailed meteorological inquiries. Amongst those recently published I may quote:

G. O. VERNON. Inquiry into the Question whether Excess or Deficiency of Temperature during Part of the Year is usually compensated during the remainder of the same Year.

—— Examination as to the truth of the Assertion that, when November has a Mean Temperature above the average, it is usually followed by excessive cold between the December and March following.

Manchester Literary and Philosophical Soc., Jan. 12, 1864, Reader, p. 211.

BIRT, on the Atmospheric Wave of November, which he defined as a great rise of the atmosphere running across the European continent from the N.W. to the S.E.; the wind by which it is accompanied is at right angles to this line, its direction being from S.W. to N.E. (From a notice I found in MOIGNO's "Les Mondes," June 2, 1864.) There also a recent work of Sir JOHN HERSCHEL's and Mr. WILL's "Conotations" are alluded to.

Occasionally bad weather from the south which does not last long will not cause much depression because it is followed by a strong north wind; and, again, good weather with northerly wind may be observed exceptionally coinciding with a low barometer, if it precedes south wind, or rain of long duration.—So far for Europe.

In India the beginning and ending of the seasons, together with the variations along the coasts, can be made objects of positive inquiry of special importance. But when entering into such details it is necessary above all that the data upon which the conclusions are to be based should be comparable; for temperature Sunrise and 4^h P.M. are the two hours best to be proposed, for the barometer 10^h A.M. might be added. If only one hour should be chosen, in order to lessen the labour of telegraphic communication and also of comparison, 9^h A.M. for Europe and $8^h\ 30^m$ A.M. for India[1] could be recommended as corresponding approximatively to the mean of the day; but this time has the disadvantage of a much more rapid change within a few minutes; in consequence, also, inaccuracy of the observer or the error of his watch is much more felt than if the *two* other epochs and both so near to the extremes of the day are chosen. At all events any combination for deducing results is but of very little use,[2] if, as it even is done to the present day in the telegramms brought by our European papers, the hour is not the same for every place.

Also the "rules of the natives" deserve attention; no doubt most of them are perfectly arbitrary, but, again, it is sufficient, if some at least call attention to conditions which otherwise might remain unnoticed for some time still. Those I got mentioned I chiefly found of some probability, if of a local character. They know how to estimate the setting in of a sea-breeze so many hours before, when the first changes in the direction or form of clouds have taken place. The track of storms along the shores and inland is too well known and deserves attention.—A late setting in of the monsún is considered to be followed by a dry season, an early monsún by a moist one; this, however, I could not prove from the analysis of my books of registers.—Quite correct I found, and coinciding with my observations, that the change in the wind into the monsún is generally first felt inland; that the *chóta*

[1] For rivers, if their temperatures are to be compared, 11^h A.M. can be considered as next to the daily mean.

[2] I also detailed this in the "Astronomischen Nachrichten," December, 1860, in my note on the "Berechnung der mittleren Tagestemperatur." In official publications the mean only is given, but too often it is the mean taken of whatever was written down; they cannot therefore be too carefully used in forming conclusions.

parsát (the first rain in April and May) precedes in the *interior* by a certain time, variable with the topographical position, the setting in of the rainy season along the coasts.—That the ending of the rains is preceded by a very general frequency of thunderstorms is true, but this is a phenomenon too irregular in itself for guidance in drawing conclusions.

In Europe the arrival of migratory birds is also frequently worth the observer's notice, chiefly if their line of migration coincides with that of the predominant direction of the winds at this season; they then show that in the place whence they come the increase of temperature has begun to be felt; and an earlier increase of temperature can be expected also with us. In India I could not observe migratory birds coming from great distances, some aquatic birds excepted, proceeding to the interior during the rains. Occasionally I saw in the Eastern Himálaya birds breeding there during the hot and rainy season of the plains, particularly of the genus of woodcocks, which, I was told, then entirely disappear from India, and only return[1] in the cool season.

The beginning and final setting in of the rains belong to the questions for which the answer may be expected obtainable at not too distant a time, if carefully deduced from positive data of distribution of temperature and moisture, by comparing, from the books of registers, what has followed in preceding years under analogous conditions. In India the alteration being only the passing of one wind into another, this, as many analogous questions, are much more easily answered than in our European regions, where climate is so much more variable with locality. Even when limited to a narrow zone and nearly to one line, I could repeatedly form during my travels already, by the telegraph, a very serviceable idea of some of the principal irregularities beforehand.—In 1855, in the middle of August, the rainy season was interrupted in the North-west provinces, which interruption lasted till the end of August. All this time the Brahman priests had performed all kind of ceremonies for softening Bhowáni and other deities; the cause of it I could trace later from my books to a depression of temperature by hailstorms to the east of Hindostán. This reduced the intensity of a moist monsún directed up the valley of the Ganges to keep the equilibrium—as it otherwise is the usual course—by rushing into the space of rarefied air produced by the vertical currents ascending from the heated plains. The ordinary state became soon restored.

When, a year later, near Ambála, on a similar occasion—delay in the setting in

[1] For details of birds see Vol. IX.

of the *chŏta parsát*—I tried to explain the existence of such conditions to one of the priests, I unexpectedly found him intelligent enough, and not less willing, to enter into what I detailed to him; I really was surprised by it, as I had a man before me so widely differing from all exterior type of European civilisation and marked as a high-caste native by his Brahminical cord; but what finally came agreed with his extraction. "How useful," he said, "when the Brahmans shall know thoroughly what the learned sáhib has begun now to explain to me; we never shall commence our ceremonies before the proper time, and," he went on quite earnestly, "our sacred power for man's perfection will become but the stronger." What could I say but, "*Sirúr*, Exactly."

Also the *frequency* of hail-storms is one of the objects which to a certain degree can easily be combined with the exact knowledge of the distribution of temperature over a larger surface. In May 1855 I find an unusual number of hailstorms from almost every part of India in my books, especially from Bengál; on looking farther back I find them preceded by local comparatively narrow groups of very rapid changes between cool and hot weeks (as chiefly in Calcutta from the beginning till about the 20th of May). Under such conditions the ascending current over the heated surface becomes the more rapid; the moisture is carried up into regions where its heat is lost equally by dilatation of vapour, as by evaporation of what has been brought up in a globular, or rather vesicular, state; a formation of solid bodies of ice is the consequence, quite analogous to the sudden appearance of solid carbonic acid on the spot upon which it was poured out in a fluid state, in consequence of the very intensive evaporation.[1]

When examining now the thirty-nine books of Indian stations, it would be easy to find many an unusual meteorological change traceable to the causes around it; but I think it is not necessary to enter into such details, not of little extent if conclusive, to direct attention to the fact that proper combinations will allow one in many instances to form a predictatory opinion at least about periods not too distant. Many are the *forms of comparison* which might be employed; as one rapid and

[1] In the tropics, as well as with us, the hailstones are much below the freezing point when gathered rapidly; see Vol. V. for detailed observations. Electricity materially cooperates in their congelation into larger bodies.

In Europe also *snow*, formed under analogous conditions into globular masses, can reach the ground before melting, particularly in spring; in the Alps it is not quite unfrequent, in the Himálaya I had no occasion to observe it. The last time I saw it take place was March 11, 1864, at home, all round the Jägersburg from Bamberg to Nürnberg.

plain, and saving at the same time the entering into further details as long as nothing of unusual character presents itself, I employed the graphical method for examining my manuscripts in the exploration of the causes of various meteorological irregularities.

Suppose good means, based upon 5 to 6 years of observation, can be used for drawing a curve for the year, sufficiently detailed to allow the single days of the running month, the one to be examined, to be marked, it is evident that this will show at once whether the temperature does or does not correspond to its mean value. If the same construction of curves be made for several stations well distributed over India—and at present already we have a great number of stations with more than 5 years of good observations—the *oscillation of temperature*[1] is represented by the distance between the standard curve and the temporary one. An analogous construction is easily made also for the barometer, and the combination of both will present in many a case, if tested by experience from previous data, sufficient material for estimates, the better if signs for the wind, the rain, the sky, &c., are added.

One or two "*Meteorological Offices*," well supplied with instruments, connected by telegraphic lines, and provided with men for comparison and combination, might best be used as principal places for every province. For signals along the coasts, for navigation, what has been done in England is the best model. The principal Central Office I should think should be placed in a position like Ágra or Ambála, not too close to the sea-shore, as are at present the observatories of the capitals, where the marine type of climate predominates too extensively, and where, very high storms excepted, the variation of the barometer is too small to allow of sufficiently recognising disturbances. Also the vicinity of the Pănjáb and Central India, where the more frequent alterations require special local attention, would be in favour of a position in the interior.

Altogether Indian climate is so much more regular than that of Europe, that some twenty to thirty offices would already prove very valuable, if well distributed over the peninsula and gradually including the eastern shores of the Bay of Bengál, some localities from the Islands of the Indian Archipelago to the south-east, Aden, and

[1] This will have the greater importance in India, whilst in Europe the atmospheric pressure must be more kept in view, the final thermical causes being too distant and too unequally distributed.

[2] The progress of studying the interpretation of the materials so obtained might be much accelerated by "Notes on the probable modifications" being sent about with the request that they might be returned with detailed explanatory remarks.

some of the telegraphic stations recently erected in the west.—Storms like that of November 5, 1864, which so unhappily approached even Calcutta utterly unnoticed, and was in consequence a visitation so much the heavier—are other inducements not to shrink from the difficulties of such attempts. Besides, Meteorological Offices have but once to be *scientifically* established and brought into co-operation, and they will soon teach themselves the rules for the progress of the work.—In Europe we should not even be placed equally well for such corresponding stations, for to the west we have the ocean, and to the north and east the vast plains of Northern Asia will remain incomplete elements for a long time still; the coasts of the Mediterranean would be about what we want to the south and south-east. Small as the region here circumscribed may appear, even the meteorological data as we possess them till now at least sufficiently show that the disturbing causes (the causes of the non-periodical variations) do not require to be sought, for Europe, much beyond these limits, since beyond them the type of the irregularities is no more the same.

It was not without hesitation I entered into making propositions of this nature; for science also teaches best not to overrate the elements at hand. But the importance for health, not less than for every branch of practical life, derived even from a very limited knowledge of the alterations in meteorological conditions, is so great, that it well deserves to be cultivated.

In India the physical conditions, well defined seasons and uniformity over large surfaces, are certainly in our favour. It must not be overlooked, however, that the first researches of this nature will lead occasionally to expect the causes to be less complicated than they will turn out, and that some time will have to pass before sufficient basis is won for researches in India, in which, though favoured, we have not even European details to guide us.

PART II.

THE THERMAL STATIONS OF INDIA.

THE NUMERICAL TABLES OF THE INDIAN PROVINCES.

The ten geographical groups formed.—Tabular arrangement.—The provincial climate.—Meteorological part of the sanitary conditions and sanitaria.

The stations I have arranged in *geographical groups*, according to the provinces indicated already on our Route-map by dotted contours. Following the principal geographical features, they are larger than the ordinary political divisions and sub-divisions; therefore, besides not being so variable, they coincide better with the modifications of the physical character to be described.

The number of the stations in India (not including the Himálaya and Tíbet, but some stations of the southern regions being added for comparison) is 250, and their distribution is the following:

1.	Eastern India: 1. Assám, 2. Khássia-hills	13
2.	Bengál and Bahár, and Delta of the Ganges and Brahmapútra	40
3.	Hindostán: the upper Gangetic plain	28
4.	Pănjáb, including the stations west of the Indus	25
5.	Western India: Rajvára, Gujrát, Kăch, Síndh	15
6.	Central India: Berár, Oríssa, Málva, Băndelkhánd	20
7.	Southern India, Mountainous Districts: 1. Dékhan and Maissúr, 2. Nílgiris	41
8.	Southern India, Coasts: Kónkan, Málabar, Karnátik	28
9.	Ceylon	11
10.	Indo-Chinese Peninsula, Indian Archipelago, and China	29

The *resulting means* are put together in a general synopsis on Plate I. of the Illustrations of the Indian Meteorology; and their graphical combination forms the object of Plates II. and III.

Within the groups the stations follow each other alphabetically,[1] to facilitate the use of the registers.

About the *tabular arrangement* of the numbers a few words will be sufficient.

The *longitude* is referred to TAYLOR's Longitude of Madras (= 80° 13′ 56″ E. of Gr.). The details of *height* are contained in Vol. II., only for some of the stations recently obtained I had to take the values (generally approximations) given together with the meteorological registers; they are marked as such by brackets. L.a. L.S. = Little above the level of the sea; for stations where detailed barometric registers had been kept also small elevations, otherwise indifferent, will be found added. Unless a station is marked in particular as a Hill or Mountain station, its height nearly coincides with that of the surrounding country.

The time of observation: the daily elements from which the means are deduced, as well as the years of the respective period, are indicated, the cases of imperfect information excepted. The period of years includes both terminal numbers.

The *temperature* is the temperature of Fahrenheit in the open air in the shade, the mean corresponding to that of the twenty-four hours[2]—glare and reflected heat being excluded, as well as too close protection in verandahs. Sunrise (SR.) is the minimum of the twenty-four hours, occasionally only with a very small difference;[3] 4^h P.M. is cooler than the maximum, but it approaches it sufficiently to be communicated separately. Where minimum and maximum had to be given on account of the hours not being precisely defined, they are the coolest and hottest hours, unless the use of registering instruments is specially mentioned. Temperatures "inside a house" are left out. In order to avoid an undue extension of the tables, the daily range, being the plain difference between the coolest and the warmest hours of observation, is not separately added.

In the last vertical column the "general mean" was added where two and more years are at hand; if a month happened to exist but in one of the years, its value in the column of the general mean is put in a parenthesis.

Corrections for reducing the monthly and yearly means to "true means," could not be applied; besides, the non-periodical variations in the tropics being so much smaller, they are of little importance.[4]

[1] In reference to spelling and alphabetically arranging see the introductory table, "Alphabet used for Transcription."

[2] Compare pp. 99 to 112. [3] Compare p. 90. [4] Compare p. 121.

In forming the arithmetical means $0 \cdot 5$ is put $= 0$, not $= 1 \cdot 0$. A full number, as "90," without a decimal following it, is not quite identical with "$90 \cdot 0$," the former meaning that no decimals are included from want of sufficient accuracy of the data, whilst in the latter case the decimal is 0. The "isolated months" were included in the "general means," unless, as very frequently indeed it was the case, their value had to be formed from a month not quite complete, though not without additional correction for the group of days wanting.

The *absolute extremes* I give for one or several stations in each of the groups are selected from the whole of the material before me, and I took care at the same time to chose such stations as, from personal inspection or acquaintance with the observer, I had reason full to believe very accurate—a precaution the more necessary as for single readings the error of instrument or observation is more apparent; whilst for a longer series, especially if the instruments and the observers are changed, there is much probability of the means of the errors being considerably reduced at least, by their not having always the same sign.

In comparing the extremes for various stations the duration of the observations is also of considerable influence. It is evident that their difference will increase with the number of years, but this is in general of greater importance for the temperate zones than for the tropics.[1]

The *thermometer in the sun's rays* is added in each group for some stations known as accurate and sufficiently comparable from personal acquaintance with the observers and instruments; the numbers here given are the monthly mean of the reading of the exposed thermometer, at the time of its highest stand—days when no direct insolation took place being excluded.

Every group is preceded by an *analysis of the provincial climate.*[2] Climate, when carefully examined, is so much varied, its description forms so important a part in every traveller's report, even if but too often concealed between many another kind of thoughts and words, that the different regions we passed offered a vast field of inquiry, and many a result perhaps not without some theoretical or practical con-

[1] For India (excluding the Himálaya) about 120° to 125° Fahr. can be considered as the absolute maximum, about 25° to 20° Fahr. as the absolute minimum till now observed; these numbers are detailed and compared with extratropic observations, p. 119.

[2] Here also the respective provincial plates of the Atlas are quoted.

nection with the conditions of the resident. The numerical results of observations, however, will easily be recognised as more precise than any words can be, as soon as we have learned to appreciate their relative value by science and experience.

Great caution must be used in speaking of such data as do not allow of numerical comparison. A temperature of 90° along the coasts is easily described as being as intolerable as one of 110° in the Pănjáb, and indeed, I can add, justly, to a certain extent, since the coincidence with moisture may make one feel the heat much more. Details about storms, however, intensity of winds, obscurity in dust storms, &c., require personal inspection over various and extended regions to allow of one's forming a judgment. A heavy storm in the tropics, a typhoon, is never reached by the wildest storm in the Pănjáb; and, again, the heat experienced there is unknown all over India, nearly over the globe.[1] From 1854 to 1858 our own travels and those of our assistants supplied me with a great variety also of descriptive data; for the years next preceding I got much information from the gentlemen whose names are connected with the stations, and by particular correspondence, from Dr. Buist, Dr. Campbell, Mr. Higgins, Mr. Hodgson, Col. Jacob, General Thuiller, Col. Vetch, &c., &c. Also the newspapers presented many welcome details for previous periods—the more useful after personal visit had taught the interpretation; for, if not overrated, I found all correct when inquiring *in loco;* such phenomena are no objects for mystification or joke, for the writer as little as for the resident reader.

The *meteorological part of the Sanitary conditions* especially depends upon temperature, moisture, malaria; the ordinary component parts of the atmosphere, oxygen, nitrogen, and carbonic acid, vary[2] within limits so narrow, that their change cannot be expected sensibly to affect the human constitution, the modification of oxygen as ozone occasionally perhaps excepted.

Food, mode of living, the construction of towns and habitations, their sewage and drainage[3]—these form another group of sanitary conditions equally important; but here I limit myself to some remarks in connexion with climate, the more as these

[1] See Group IV., "Pănjáb."

[2] The chemical analysis of the atmosphere is contained in Vol. V.

[3] Till now even the greatest towns, such as Calcutta, could but very insufficiently protect themselves against the mode of living of the native co-habitants, which produces an infection of the atmosphere of the most deleterious and repudiant character. Great measures were proposed to be taken before the setting in of the hot season of 1864, at least at Calcutta, but even there much resistence is feared from the natives. "Report on Food," published for the medical Department, by Macpherson, Calcutta, 1863.

questions, and especially their relation to European residents, has so often been made the object of detailed reports.[1]

What, I think, I must especially allude to, is the circumstance that a temperature beyond a certain degree, though it may suit other races very well, is a limit to permanent settlement and colonization for Europeans; such was, I can say, more or less modified, the answer of by far the greater part of the gentlemen consulted, as well as my own and my brother's reply,[2] when the various opinions were asked before the Parliamentary Committee. Railways may have an unexpected and considerable importance by their facilitating to settlers a change of climate more easily and more rapidly, when the health begins to become affected. Drainage, beneficial as it may be locally, always remains too much limited to become of general importance.

As a temporary refuge for those who cannot reach home, Sanitaria in mountainous regions and on islands were established.

In *Hill-Stations* the elevation is one of the most effective causes for appreciably cooling the temperature, if it reaches a sufficient height; but below this, unless of the form of isolated mountains and ridges, its influence is felt but little, particularly in the hot season. In Maissúr, in the Dékhan, we have numerous instances of the heat becoming even more intensive on these plateaux than at the very level of the sea, where it is modified by a not too great distance from the ocean. I have taken care, however, to collect all the most recent data[3] in reference to the mountainous Sanitaria also to the south of the Himálaya, where their isolated position makes them more important than climate alone would.

The decrease of atmospheric pressure is not yet considerable enough in any of Indian Sanitaria to exercise, as in the Himálaya and in Tíbet it does, a very appreciable influence, except on delicate constitutions.

Marine Sanitaria on islands, as the maps of isothermal lines will show, may be expected to differ but little from the climate of the Indian coasts; places can be

[1] As the most recent general data I quote those contained in the Parliamentary publication "Reports from the select Committee on Colonization and Settlement," 1858, in addition to those publications of the "Commission on the Sanitary State of the Army in India" to which I have already repeatedly had occasion to refer.

Also the "Medical Topographies," &c., quoted in the tables of literature, are rich in details about the sanitary conditions of various provinces.

[2] "Colonisation and Settlement," Report 5th, pp. 1 to 10.

[3] Many of them only reached me at the end of last summer, and therefore could not be included in my "Numerical Elements of the Meteorology of India," in the Transactions of the Royal Society.

found where, without the means being cooler, the breezes are more regular and more refreshing and the atmosphere decidedly purer; malaria, if existing, can much more easily be removed where all around is the open sea, and no neighbouring tracts are to be feared equally jungly and deleterious as the one to be purified. The temperature may be said to remain throughout too warm for Europeans, and therefore relaxing, a few months of the cool season excepted.

Of the diseases frequent among the natives cholera[1] and fevers are particularly dangerous.

In loco every station complains more or less, but on a change of residence the remembrance generally becomes decidedly milder. When examining the Reports made to Parliament by the military and medical officers of the Indian Army, we may be rather surprised that not one station is met with, I dare say, the reporters of which would not manifest certain tendency at least to show that in other regards neighbouring stations or those of a different climatological character may be worse still; and if we consider that those who report are those who have suffered all the inconveniences, we can but acknowledge their courage; "*je souffre, mais je ne me plains pas*," is their devise, as long as it cannot be helped. But unless interpreted by one's own experience, it might perhaps at first be understood too mildly before entering into the examination of the numerical data of temperature and mortality.

Statistical tables, including the diseases of various elements of native population could nowhere be found; some numerical data I got for several towns are chiefly based upon the conditions of the Europeans.

[1] The most savage tribes are not those least suffering when it breaks out. In the Khássia Hills, where every corpse is burnt, it is done so rigorously that in the rainy season they absolutely conserve them in honey till the ceasing of the rain allows of the burning. (Compare Hooker, "Himálayan Journals," Vol. II., p. 276, and Emil Schlagintweit, "Buddhism in Tíbet," p. 269.) A few years ago (1855) the cholera, beginning close to Cherrapúnji, broke out with such violence, that many a body had to be thrown into the ravines, whence I succeeded in consequence in obtaining the first skeleton of this race.

GROUP I., EASTERN INDIA:

ASSÁM AND THE KHÁSSIA HILLS.

1. ASSÁM.

Bărpétah.	Golaghắt	Naziruaghắt.
Dibrugắrh.	Lăkhimpúr.	Sibsắgar.
Goalpára.	Măngaldái.	Tézpur.
Gohátti.	Naugóng.	

Assám, by geographical position, is situated next to the northern limit of the tropical region. Though in other parts of India the same and even higher latitudes still show, with scarcely any modification, the full character of a tropical climate, we find in Assám, in reference to the Indian seasons and the monsuns, a remarkably cool winter without a corresponding excessive temperature in summer, and, what is more important still, a marked alteration in the ordinary direction of the wind, which, however, does not exclude a very great amount of rain.

The most prevalent winds in Assám are those blowing down the valley in a north-easterly direction; this is another proof, as I shall have occasion to detail when examining the winds, that Assám in winter as well as in summer is cooler than the delta below it; whilst in the Pănjáb, exceedingly cool as it is in winter, the very heat of its summer months causes an inversion in the direction of the winds.

For Assám the vicinity of the Himálaya and partly also of the Khássia and Nága Hills may have a slight influence on cooling the temperature and so favouring the direction of the wind towards the hotter region of the delta of Bengál; but for the cold season at least the north-easterly winds have a much more general cause. They are here the most northern limit of the periodical winds tending to restore the equilibrium of temperature and pressure between the tropical seas and the continent

surrounding them. In summer the south-west monsun exists also in Assám, but in general *is felt* along the surface only as far as Bishnáth. From there it seems to continue its course at some elevation above the ground on account of its very difference of temperature.[1] The direction of the clouds, as well as the considerable amount of precipitation during the rainy season, show it to exist there.

The *cool season* here is characterized by the presence of heavy fogs. The beginning of their formation coincides with the minimum of temperature in the daily period; they continue for two to four hours depositing a great quantity of moisture on trees, houses, and all similar prominences, and afterwards rise up as isolated cumuli. In consequence of the prevalent winds being N.E. they have a decided tendency to occupy the south side of the valley. Small as may appear the surface actually covered by the Brahmapútra,[2] even if we include the lateral jhils the inundation of which depends upon the height of its water, there is no doubt, if we watch the beginning of the formation of these fogs, that they are essentially generated along the bed of the river; also a well-marked haze is often seen resting over the river even long after the dissipation of the general fog. These fogs are more frequent in February than in January; in some years to such a degree that the monthly mean of February is even depressed under that of January.

The *hot season* is less excessive in temperature and more frequently interrupted by rain than in India, even along the coast of Bengál; but the moisture of the atmosphere makes the heat more close and oppressive; the nights, however, are frequently enough comparatively cool and refreshing.

The *rains* are of long duration: they often commence in March and last till about the middle of October; from May to September the rainy season is but little modified and the precipitation is very great. "In general," says Dr. Leskie, a long resident of Góhátti, "the rains commence in April and May, with intervals of fine weather. During July, August, and September the heaviest showers fall, but even in these months there are dry days, and the rain seldom falls for twenty-four hours without intermission and scarcely ever for two days."

[1] Compare for an analogous modification in the direction of the hot winds of Hindostán, which I observed to take place after sunset, in Group "Hindostán."

[2] The total surface of Assám, as limited by Sădia and Goalpára occupies an area of 30,000 square miles with an average breadth of about sixty miles, whilst the general breadth of the Brahmapútra scarcely reaches two miles, even including the *chărs,* or sandy moveable islands.

The *healthiness* as well as the diseases[1] vary considerably with the seasons; the beginning of the rainy season, and occasionally the period following its end, are, as everywhere in the tropics, the most unhealthy times of the year; fevers, often of a malignant character, prevailing. In the cold season, chiefly about the end of January, catarrhs, affections of the throat and the lungs, are prevalent, also leading to bronchitis. Cutaneous ulcerations are also very numerous with the natives, especially at the beginning of the hot season. Dysentery is not unfrequent; with the natives its cause is but too often an indulgence in opium, in which also many of the women partake.[2] For Europeans fever is the disease to which they are most exposed.

In reference to *cultivation* the Assám climate may be quoted as especially favourable for tea plantations. About 1830 Mr. BRUCE first discovered the tea plant in an apparently wild state, at all events perfectly unknown to the present generation of inhabitants; in 1855 and 1856 I found tea plantations existing already, successful but very small. On the hill near Tézpur, figured in the Atlas, where my tent was pitched, I still could point out tea plants in the jungly wilderness; and now all these hills in sight are covered with plantations; in 1862 the commissioner kindly wrote to me from Gohátti, that the ground cultivated with tea amounted to 654 acres, the quantity of tea obtained to 193,900 pounds, of the value of 72,800 rupees, corresponding to a return of nearly 25 per cent.—Also all over the southern parts of the Himálaya a most successful cultivation of tea has been rapidly effected; there climate is more favorable still; for, in Assám, though the monthly means, as we have seen above, remain cooler than might be expected for this latitude, when compared with regions farther to the west, the absolute extremes remain tropical enough in summer.

Earthquakes are frequent in Assám, chiefly in November, December, and January, when I, too, had occasion to observe several shocks along the right bank of the Brahmapútra. Also in the meteorological registers I found them regularly

[1] Details about the diseases are to be found in: LESLIE's "Account of the Diseases of Gowhátti;" McLEOD's "Topography of Bishnath;" and McCOSH's "Topography of Asam;" as well as in ROBINSON, "Descriptive Account of Asam."

[2] Before the introduction of the government opium from Bengál, opium was very generally cultivated by the natives; they used to collect it by wiping the heads of the poppy, some days after incisions had been made, with rags, which when the draught was to be prepared were stewed in a little hot water. Major VETCH was kind enough to add to my collections some specimens of these rags he had kept.

noted; the natives considered them to be connected with meteorological phenomena—"at least," as they told me, "with the dissolving of fogs." The Europeans but too generally think of atmospheric pressure being affected simultaneously; but the most careful examination did not allow me to discover a connexion.

The details I shall give in the geological volume; here one result only, unexpected for me, may be mentioned as being occasionally an assistance not indifferent for judging of the connection with atmospheric changes, if any should exist—I mean the velocity of the propagation of the shocks. In the alluvial soil forming the *surface* of the valley of the Brahmapútra in its full breadth, from the Himálaya to the Khássia and Nága mountains, with a granitic base below it and isolated granite hills, the propagation is decidedly less rapid than that of sound. I had three times occasion[1] to hear the horrifying shouts from a village where a shock had been felt, before the shock reached my encampment; a comparison of the distance and time gave about 1,000 to 1,005 feet in one second, when I adopted NEWTON's value for sound = 1,140 feet in one second; the temperature was 62° Fahr.

I may be allowed to add here that the observation of sound only allowed of my estimating the propagation when my position was *in the line* of the propagation, the waves coming towards me; in the direction *at right angles* to it, the neighbouring places felt the shock simultaneously with me; in fact what I observed may perhaps best be compared to a stream rushing forwards with a breadth not well limited and with an intensity decidedly decreasing towards its lateral margins, but not in its longitudinal direction.

The *absolute extremes* of temperature, given here are those communicated for Gohátti in Dr. LESLIE's "Account of the Diseases at Gohátti."

The *mean insolation* is deduced from the observations made by myself and my assistant Lt. ADAMS, together with Mr. SIMONS, 1855 to 1856; from October to December it is decidedly more powerful than might be expected from the elevation of the sun: atmospheric humidity in transparent state and the hibernal distance of the sun materially increasing the effect of the sun's rays.

[1] For details see Vol. VI., Geology.

[2] As the value now best defined for the velocity of *light*, 41,549 geogr. miles (1 = $^1/_{15}$ degree = 4 nautical miles) per second, is adopted. For details see HUMBOLDT, "Kosmos," Vol. III., p. 92.

Absolute extremes at Gohátti.

Months.	Extremes.		Months.	Extremes.	
	Min.	Max.		Min.	Max.
January	48	73	July	76	88
February	48	80	August	74	91
March	52	90	September	70	90
April	60	90	October	67	87
May	60	92	November	58	81
June	70	91	December	49	73

Dr. Leslie states that at Bishnáth and Somháth the thermometer has been more than once seen at 45° Fahr. in the cool season, and 98° Fahr. in the hot season.

Mean Insolation at Gohátti, 1855 to 1856.

January	86	July	107
February	92	August	98
March	100	September	106
April	104	October	109
May	104	November	104
June	106	December	100

Plates to be compared: Aspect of Central Assám, with a heavy rainy storm overhanging the valley of the Brahmapútra. Part III., No. 20.

A Morning in the cool Season in Assám, river view, near the southern end of the *Mólung Hills*. Part IV., No. 21.

BĂRPÉTAH.

Latitude North.	Longitude East Green.	Height.
26° 18	91° 0′	100 feet

1850-2. Approximated means, communicated by Col. JENKINS.

SCHLAGINTWEIT, Met. Mscr., Vol. 16.

Months.	1850	1851	1852	General mean.
	Mean of the month.			
January	....	62·5	62·0	62·2
February	....	64·5	68·0	66·2
March	....	72·0	70·0	71·0
April	....	76·0	75·5	75·7
May	....	78·5	....	78·5
June	....	80·0	....	80·0
July	....	82·0	....	82·0
August	....	83·0	....	83·0
September	....	82·5	....	82·5
October	....	88·5	....	88·5
November	70·5	71·5	....	71·0
December	64·5	66·0	....	65·2
Year	....	75·6	....	75·5

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·5	75·1	81·7	80·7	75·5

DIBRUGÁRH.

Latitude North.	Longitude East Green.	Height.
27° 32′·0	94° 57′·6	396 feet

1851, Journ. As. Soc., 1852.
1853, Isolated months by CAMPLIN: SR.; 9^h 50^m; 12; 2; 4; SS.
1853-5, HIGGS, very carefully put up: SR.; 12; 4; SS.

SCHLAGINTWEIT, Met. Mscr., Vol. 15. (Compare Lăkhimpúr), also BRUCE, LEAN, and MOIR had periodically cooperated in making these observations.

Months.	1851	1853			1854			1855			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	63·6	47·0	61·9	54·4	66·1	77·2	71·6	....	....	....	62·2
February	63·7	56·6	71·6	64·1	49·7	75·1	62·4	60·8	66·3	63·5	63·4
March	73·1	69·2	79·8	74·5	57·6	80·5	69·0	64·0	73·1	68·5	71·3
April	73·5	64·1	80·6	72·3	64·3	82·2	73·2	69·1	74·4	71·7	72·7
May	76·2	67·7	84·8	76·2	....	....	....	76·1	81·7	78·9	77·1
June	80·4	74·2	86·8	80·5	....	....	....	78·4	84·0	81·2	80·7
July	85·4	75·2	87·6	81·4	....	....	....	80·2	88·3	84·2	83·7
August	82·2	73·4	89·1	81·2	80·6	83·8	82·2	79·2	84·2	81·7	81·8
September	....	74·2	79·6	76·9	80·2	85·2	82·7	79·9	87·2	83·5	81·0
October	....	66·6	82·0	74·3	74·9	80·0	77·4	72·1	81·8	76·9	75·6
November	....	56·0	73·5	64·7	66·9	72·0	69·4	63·1	72·2	67·6	67·4
December	....	49·2	72·2	60·7	57·4	68·9	63·1	....	....	....	61·0
Year	....	....	....	71·8	....	....	....	....	....	....	73·2

Isolated months (means), by CAMPLIN. 1852: November 67·8, December 59·3; 1853: Jan. 59·3, Oct. 73·7.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·2	73·7	82·1	74·7	73·2

GOALPÁRA.

Latitude North.	Longitude East Green.	Height.
26° 11′·0	90° 36′·6	120 feet

1850-4. HARRIS, REDSDALE, and their native Assistant, SR.; 10; 4; SS.

For 1851 from April I had to take the means from the Asiatic Journal 1852, which seem based on SR. and 4h P.M. SCHLAGINTWEIT, "Met. Mscr.," Vol. 16.

Months.	1851			1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	57	69	63	56	68	62·0	55	66	60·5	61	74	67·5	63·2
February	59	71	65	62	76	69·0	62	77	69·5	..	..	....	67·8
March	65	84	74·5	65	77	71·0	65	88	76·5	64	82	73·0	73·7
April	..	..	77·6	70	84	77·0	74	91	82·5	70	80	75·0	78·0
May	..	..	79·3	75	84	79·5	76	89	82·5	76	83	79·5	80·2
June	..	..	79·9	77	83	80	77	83	80·0	78	81	79·5	79·8
July	..	..	81·3	78	82	80	80	85	82·5	80	84	82·0	81·4
August	..	..	81·8	79	85	82	79	84	81·5	79	83	81·0	81·6
September	..	..	82·1	77	82	79·5	78	84	81·0	79	85	82·0	81·1
October	..	..	77·9	74	83	78·5	73	83	78·0	75	84	79·5	78·5
November	..	..	71·6	64	75	69·5	65	75	70·0	68	75	71·5	70·6
December	..	..	65·8	59	71	65·0	58	72	65·0	59	69	64·0	64·9
Year	for 1851: 75·0			for 1852: 74·4			for 1853: 75·8			..	..	..	75·1

Isolated months (means). 1849: Dec. 62; 1850: Jan. 60, April 75·5.

General mean of the season and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·3	77·3	80·9	76·7	75·1

GOHÁTTI.

Latitude North.	Longitude East Green.	Height.
26° 5′·8	91° 43′·8	134 feet.

1850-6. SIMONS, very detailed. SR.; 10; 4; SS.; 10. (SCHLAGINTWEIT, "Met. Mscr.," Vol. 16.)

The months wanting for 1851 had been sent away by the medical board to be published in the Asiat. Soc. Journ. for 1852; but there the means for warmer months are, by an improper combination of the hours, much too hot. I have omitted them.

Months.	1850			1851			1852			1853			1854			1855			1856			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	..	..	....	59	70	64·5	57	71	64·0	57	68	62·5	59	74	66·5	58	63	60·5	62	65	63·5	63·6
February	..	..	....	62	72	67·0	65	77	71·0	63	77	70·0	59	73	66·0	63	72	67·5	64	64	64·0	67·6
March	..	..	....	68	83	75·5	68	74	71·0	70	85	77·5	65	82	73·5	71	77	74·0	72	77	74·5	74·5
April	74	82	78·0	..	..	....	71	79	75·0	77	89	83·0	71	78	74·5	75	78	76·5	75	80	77·5	77·4
May	74	85	79·5	..	..	....	77	80	78·5	78	86	82·0	78	90	84·0	78	81	79·5	77	81	79·0	80·4
June	80	85	82·5	..	..	....	80	82	81·0	81	86	83·5	80	82	81·0	80	82	81·0	81	83	82·0	81·8
July	81	85	83·0	..	..	....	81	83	82·0	83	88	85·5	81	83	82·0	82	85	83·5	81	83	82·0	83·0
August	81	84	82·5	..	..	....	82	85	83·5	81	84	82·5	82	87	84·5	81	84	82·5	81	83	82·0	82·9
September	82	83	82·5	..	..	....	81	83	82·0	80	84	82·0	81	84	82·5	80	83	81·5	81	84	82·5	82·2
October	76	84	80·0	..	..	....	77	82	79·5	76	84	80·0	77	81	79·0	76	80	78·0	78	80	79·0	79·2
November	67	76	71·5	..	..	....	66	74	70·0	66	76	71·0	70	74	72·0	..	..	....	71	75	73·0	71·1
December	60	70	65·0	..	..	....	62	73	67·5	58	71	64·5	63	67	65·0	..	..	....	..	..	....	65·5
Year	..	..	....	..	..	....	1852: 75·4			1853: 77·0			1854: 75·9			..	..	....	..	..	....	75·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·6	77·4	82·6	77·5	75·8

GOLAGHÁT.

Latitude North.	Longitude East Green.	Height.
26° 33′	93° 58′	350 feet

1851. Communicated by Col. JENKINS, SR., 4.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 16.

1851				1851			
Months.	SR.	4^h	Mean.	Months.	SR.	4^h	Mean.
January	47	72	59·5	July	74	95	84·5
February	46	77	61·5	August	78	92	85·0
March	59	84	71·5	September	76	90	83·0
April	64	89	76·5	October	71½	87	79·2
May	69	90	79·5	November	54	78	66·0
June	74	89	81·5	December	44	76	60·0
						Year	74·0

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
60·3	75·8	83·7	76·1	74·0

LĂKHIMPÚR.

Latitude North.	Longitude East Green.	Height.
27° 31′	94° 55	410 feet

1851. Communicated by Mr. BRUCE, SR. and 4.

In a temporary settlement on the right shore of the Brahmapútra (about opposite Dibrugårh; the means of the seasons very well agree with those of Dibrugårh). (SCHLAGINTWEIT, "Met. Mscr.," Vol. 16.)

1851				1851				1851			
Months.	SR.	4^h	Mean.	Months.	SR.	4^h	Mean.	Months.	SR.	4^h	Mean.
January	53	69	61·0	April	66	81	73·5	....	..	..	....
February	55	70	62·5	May	66	93	79·5	November	53	79	66·0
March	62	75	68·5	June	72	92	82·0	December	48	77	62·5

Mean of the seasons.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·1	73·8	....	....	....

MĂNGALDÁI.

Latitude North.	Longitude East Green.	Height.
26° 24′	92° 1′	155 feet.

1851-2. Communicated by Col. JENKINS. Means of Daily Extremes.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 16.

1851				1852	
May	80	September	81·5	January	66·5
June	79·5	October	78·5	February	69
July	82·5	November	71·5	March	70
August	82	December	64·5	April	77

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·7	75·7	81·3	77·2	75·2

Naugóng.

Latitude North.	Longitude East Green.	Height.
26° 21′	92° 49′	250 feet

1851-4. Murray; only approximate means from extremes.

Schlagintweit, "Met. Mscr.," Vol. 16.

Months.	1851	1852	1853	1854	General mean.
	Mean of the month.				
January	....	59·5	58·5	66	61·3
February	67	68	66	64·5	66·4
March	72	71	73·5	71·5	72·0
April	75	75·5	79·5	75·5	76·4
May	78 5	81·5	82	82·5	81·1
June	81	84	85·5	83	83·4
July	83·5	82	85·5	85	84·0
August	83·5	85·5	83·5	85	84·4
September	83	82·5	82·5	85	83·2
October	78·5	76	78	82	78·6
November	70·5	69·5	69·5	....	69·8
December	63·5	63	64	....	63·5
Year	....	74·9	75·7	....	75·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
63·7	76·5	83·9	77·2	75·3

Naziruaghát.

Latitude North.	Longitude East Green.	Height.
26° 52′	94° 42′	400 feet

1840-2. Masters. Calcutta Journ. Nat. Hist. IV., p. 438. SR.; 2; SS.

The same observations are also contained in Dove's Temperaturtafel, 1846, pp. 196-7, under the name Nazera.

Months.	1840	1841	1842	General mean.
	Mean of the month.			
January	58·9	61·3	61·1	61·4
February	64·4	63·7	64·6	64·2
March	71·2	66·3	66·6	68·0
April	74·2	70·7	71·2	72·0
May	79·2	76·0	80·0	78·4
June	81·0	81·7	81·8	81·5
July	84·5	83·0	80·7	82·7
August	83·1	81·0	81·8	82·0
September	80·9	81·7	82·6	81·7
October	79·1	76·1	76·2	77·1
November	67·4	67·5	67·2	67·4
December	60·4	60·9	60·0	60·4
Year	73·7	72·5	72·8	73·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·0	72·8	82·1	75·4	73·0

Sibságar.

Latitude North.	Longitude East Green.	Height.
27° 2′	94° 39′	370 feet

1851, Journ. As. Soc., 1852. Probably these values are the mean of Extremes.
1852-4, Johnstone, SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 15.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	60·0	52·7	67·0	59·8	52·1	64·5	58·3	53·6	71·9	62·7	60·0
February	62·3	63·6	72·4	68·0	59·0	70·8	64·9	56·9	69·6	63·2	64·1
March	70·5	62·5	72·7	67·6	63·2	77·3	70·2	62·6	75·6	69·1	69·3
April	72·8	66·9	80·5	73·7	69·3	80·6	74·9	....	....	....	73·8
May	77·6	75·2	82·4	78·8	72·7	83·0	77·8	74·9	81·1	78·0	78·0
June	82·6	78·3	84·8	81·5	78·8	87·2	83·0	79·4	85·8	82·6	82·4
July	84·4	79·2	85·0	82·1	80·5	87·7	84·1	79·6	87·8	83·7	83·6
August	84·1	80·3	88·5	84·4	79·1	84·8	81·9	80·4	86·6	83·5	83·5
September	84·1	77·9	86·5	82·2	80·9	84·0	82·4	78·8	89·1	83·9	83·1
October	79·2	73·7	83·7	78·7	72·6	82·6	77·6	73·3	82·5	77·9	78·3
November	71·4	62·5	74·5	68·5	62·6	73·5	68·0	66·0	74·7	70·3	69·4
December	65·8	54·7	68·3	61·5	52·3	70·3	61·3	55·8	68·7	62·2	62·4
Year	74·6	1852: 73·9			1853: 73·7					....	74·0

Isolated months (means), included in the general mean. 1850: Nov. 69, Dec. 61; 1851 (by Johnstone): Jan. 59·3, Febr. 62·1, Oct. 78·1.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·2	73·7	83·2	76·9	74·0

TÉZPUR.

Latitude North.	Longitude East Green.	Height.
26° 34′·6	92° 46′·8	278 feet

1851-5, BRUCE, HARRY. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 15.

Months.	1851			1852			1853			1854			1855			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	52·2	73·7	62·6	50·1	69·2	59·6	50·1	71·5	60·8	50·1	69·0	59·5	45·1	67·0	56·0	59·7
Febr.	57·6	72·7	65·1	58·8	75·7	67·2	54·5	75·7	65·1	56·2	65·2	60·7	55·3	66·6	60·9	63·8
March	63·7	81·6	72·6	59·5	78·3	68·9	66·5	79·5	73·0	56·2	77·3	66·7	56·4	76·7	6·5	69·5
April	66·5	84·5	75·5	67·3	83·4	75·3	71·5	91·5	81·5	64·3	80·0	72·1	65·2	71·2	68·2	74·5
May	73·1	83·6	78·3	73·6	86·3	79·9	75·7	91·2	83·4	70·3	81·9	76·1	72·8	80·8	76·8	78·9
June	76·9	85·9	81·4	77·6	90·1	83·8	78·1	90·6	84·3	76·1	85·2	80·6	76·6	83·4	80·0	82·0
July	81·0	87·0	84·0	....	....	....	81·9	86·4	84·1	76·7	87·0	81·8	78·1	87·2	82·6	82·7
Aug.	80·5	86·5	83·5	....	....	....	75·4	84·7	80·0	76·2	82·2	79·2	78·0	87·3	82·6	81·2
Sept.	77·6	87·5	82·5	77·5	87·1	82·3	73·8	84·6	79·2	77·8	86·8	82·3	75·6	85·4	80·5	81·3
Oct.	73·4	83·5	78·4	72·0	85·1	78·5	70·8	82·9	76·8	68·7	80·0	74·3	70·4	83·8	77·1	77·0
Nov.	61·1	78·1	69·6	58·9	77·9	68·4	57·5	67·3	62·4	61·8	83·0	72·4	....	....	....	68·5
Dec.	56·2	72·3	64·2	53·1	71·2	62·1	53·7	68·0	60·8	51·6	69·4	60·5	50·5	68·3	59·4	61·3
Year			1851: 74·8	....	....	....			1853: 74·3			1854: 72·2	....	....	....	73·4

Isolated months (means), included in the general mean. 1850: Oct. 77·2, Nov. 69·9, Dec. 61·0; 1856: July 80·8 Aug. 81·2.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·6	74·3	82·0	75·6	73·4

2. THE KHÁSSIA HILLS.

CHERRAPÚNJI.—SHÍLLONG.

The climate of the hilly ranges along the left side of the Brahmapútra valley, the Gáro, Khássia, and Nága Hills, varies considerably for the different parts with the elevation; the inhabited places are included, on an average, between 4000 to 6000 feet.

The observations at Cherrapúnji compared with those of Silhét give 300, compared with Gohátti 335 feet, for the decrease of 1° Fahr.

The *cool season* in the higher elevations is remarkably pleasant, but from April, when the *rainy season* begins with a violence unknown in any other place on the globe, the southern border of the hills is in a most unfavourable climatological condition. Without entering into the details, which will form the special object of another part of this volume, I may mention here that the average annual amount of rain reaches 600 to 620 inches; in June occasionally 8 to 10 days are found noted in my registers as rain without any interruption, day and night; the quantity of rain is the greatest in the afternoon and, particularly, in the first hours of the night.

From the middle of October there is generally no more rain at all, but the moisture is nevertheless very great; also hazy fogs are frequent, and heavy dews fall every morning.

The observations here communicated chiefly refer to Cherrapúnji, representing with little variation all the southern margin of these hills; but also in the very centre of this mountainous region, though the rain is reduced to about one-third or even one-fourth, the dampness is still excessive throughout the year. The decrease is but little more rapid in the cool season when calculated from comparison with a lower station in Assám, and more slow in the rainy season, when deduced from Bengál as well as from Assám.

The valleys—very steep narrow cuts—are very hot in summer; in winter they rae occasionally swept by gales of cold wind felt as far down as Silhét.

A. Absolute extremes at Cherrapúnji.

From observations by Dr. Fletcher, 1853-1855.

Months.	Extremes.		Months.	Extremes.	
	Min.	Max.		Min.	Max.
January	44	61	July	63	80
February	44	70	August	63	84
March	51	74	September . . .	61	74
April	61	74	October	60	74
May	62	76	November	51	70
June	62	74	December	44	64

B. Mean Insolation at Cherrapúnji.

From observations by Dr. Fletcher, 1855. The instruments were carefully put up, and compared by me in September. The insolation is very low throughout the year in consequence of a considerable amount of moisture in condensed form floating in the atmosphere.

January.	70	July	92
February	75	August	86
March	78	September	82
April	87	October.	79
May	89	November	76
June	87	December	[illegible]

CHERRAPÚNJI.

Latitude North.	Longitude East Green.	Height.
25° 14′·2	91° 40′·5	4,125 feet

1832-6. Approximate means. TAYLOR, "Topography of Dakka," Calcutta, 1840, p. 16.

1851, from July to October, based on OLDHAM's "Most careful observations at 3; 9; 3; 9." "Geology of the Khasi Hills," Appendix.—Observations by Dr. FAYRER; they were made at SR.; 9h 50; 12; 2h 40; 4; SS., therefore his "means" are naturally too hot; they are contained in As. Journ. 1852; as I had not the original details, I have left them out.

1852-5. FLETCHER. SR.; 10; N·; 2h 40′; 4; SS. SCHLAGINTWEIT, "Met. Mscr.," Vol. 17.

1859-60. Observations by Dr. DILLON, Parl. San. Rep., Vol. II., p. 148; at SR., 10; 4; 10; the mean being take from all these hours together makes it several degrees too warm; this I found also confirmed by a comparison with the hourly observations I had occasion to make there in 1855.

1859-60. Means without detail of hours. Parl. San. Rep., Vol. II., p. 148.

Months.	1851	1852			1853			1854			1855			General mean.
	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	....	49·9	57·2	53·5	45·8	52·5	49·1	50·0	59·1	54·5	46·8	53·2	50·0	51·8
February	....	52·0	60·4	56·2	50·7	58·9	54·8	50·2	58·6	54·4	49·7	57·1	53·4	54·7
March	....	52·8	67·8	60·3	58·6	68·0	63·3	57·7	67·6	62·6	56·5	63·6	60·0	61·5
April	....	59·2	66·7	62·9	62·0	68·8	65·4	59·7	65·7	62·7	60·5	65·9	63·2	63·5
May	....	64·9	68·2	66·5	62·5	69·8	66·1	65·2	73·3	69·2	64·7	69·7	67·2	67·2
June	....	63·6	69·3	66·4	63·0	69·5	66·2	66·0	69·1	67·5	66·6	70·3	68·4	67·1
July	69·7	62·8	66·1	64·4	65·2	70·8	68·0	67·9	72·5	70·2	67·7	72·9	70·3	68·5
August	70·1	65·5	69·8	67·6	62·9	68·0	65·4	66·9	70·0	68·4	67·4	70·7	69·0	68·1
September	69·5	64·4	69·6	67·0	62·5	66·8	64·6	67·5	72·6	70·0	66·1	70·8	68·4	67·8
October	66·4	61·7	67·7	64·7	61·4	68·3	64·8	63·8	69·6	66·7	63·8	68·6	66·2	65·8
November	61·5	54·3	60·9	57·6	52·8	60·1	56·4	57·1	62·8	59·9	....	....	....	58·8
December	....	50·9	57·1	54·0	....	....	....	51·5	61·1	56·3	....	....	....	55·1
Year	....	1852: 61·7					....	1854: 63·5					....	62·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
53·9	64·1	67·9	64·1	62·5

SHÍLLONG.

Latitude North.	Longitude East Green.	Height.
25° 32′	98° 52′	(5,600 feet)

1860. SR.; 10; 4^h; 10^h; Major RICHARDSON; the instruments were registered by Híngun Khan. The site is proposed for the erection of a new Hill station chiefly on account of the rain being here only about one-third of the amount in Cherrapúnji. Selections from the records of the Gov. of Indian Mil. Dep., 1862, No. II., pp. 74, &c.

1860.	SR.	4^h.	Mean.
August	64·5	66·3	65·4
September	63·7	68·1	65·9
October	58·8	66·2	62·5

Plates to be compared:

Cane Suspension Bridge over the Témshang river, in the Khássia Hills; an instance of wild subtropical[1] vegetation; Part I., No. 5. *The Waterfalls near Chérrapúnji*, in their full power, after the rains, are to come with the next volume, in Part V. of the Atlas.

[1] *Subtropical* I call, with HUMBOLDT, a region next to the tropics, participating in many of their physical conditions without geographically belonging to them.

GROUP II., BENGÁL AND BAHÁR,
AND DELTA OF THE GANGES AND BRAHMAPÚTRA.

Bākúra.	Chápra.	Húgli.	Parisnáth.
Bărdván.	Chendvár Hill.	Jamíra Pat.	Pắrnea.
Barisál.	Chittagóng.	Jessór.	Pátna.
Barrakpúr.	Chunár.	Kachár.	Rámpur Bólea.
Bérhampur.	Dáinajpur.	Kishánpur.	Rắngpur.
Bhāgalpúr.	Dămdắm.	Maimănsíngh.	Ranigắnj.
Birbhúm.	Dḗri.	Mídnapur.	Rhotásgărh.
Bógra.	Dháka.	Monghír.	Silhét.
Calcutta.	Fărídpur.	Murshedabád.	Típpera.
Chaiabásso.	Gáya.	Noakólli.	Tirhút.
Chandernagúr.	Hazaribágh.	Pắbna.	

The *climate of Bengál* participates in the modifications produced by tropical seas, but, at the same time shows the influence of the continental regions surrounding the bay of Bengál. Along the coasts on either side of Southern India and the Indo-Chinese peninsula, as well as in the Archipelago, we shall find much smaller variations; but here the cool season occasionally still reminds one of the fogs of Assám, chilly, at least for the tropics; and in the period preceding the rains a blaze of hot winds from the north-west may be felt, though the temperature more than the moisture of the atmosphere becomes affected, and so the days of heat rather contribute here to help on vegetation to reach the very apex of tropical luxuriance; whilst higher up, in Hindostán and the Pănjáb we meet with regions where heat and drought for a time are scarcely less destructive to leaf and blossom than cold and drought in Tíbet.

In the southern and eastern parts of Bengál, which I shall describe first, as they include the districts the most characteristic in climate and the largest in

surface, the slope of the ground towards the sea is so gentle that in the dry weather, when the rivers are lowest, the tide attains, even at Dháka, a height of 2 to 4 feet at new and full moon, and is perceptible about twenty miles above the town.

During the *cool season*, already from September, dews and fogs are of constant occurrence; in the mornings they continue till February; the nights are generally damp and unpleasant; but again, at times the sky is clear, allowing a strong nocturnal radiation, and exceptionally even ice is mentioned to have been obtained at Dháka in shallow earthen vessels exposed during the night. This must probably be considered as the utmost limit of the formation of ice by radiation.

Sudden squalls from the north-west are not unfrequent during the month of February. They often assume a character of extreme violence. When going down the Mégna in February 1856 I experienced two such storms, which my native companions declared to be perfect types, quite "assal."[1] These storms generally begin about sunset or late in the afternoon, and often, already a day or two before, heavy dark clouds are seen collecting in a north-westerly direction, which, however, may disperse after some electric discharges have taken place along their borders.

When a storm comes to its full outbreak, dark, semi-globular masses rise a little above the horizon and soon considerably increase in size, partly from actual accumulation of moisture, partly from the rapidity of their progress in the direction of the observer. The lower parts seem to be pushed forward rather more than the upper ones; for I had most decidedly the impression (and the natives with me told me that it was generally the case), that the line from the upper margin to the lower one was inclined in the direction of the wind which made it approach. Nevertheless no horizontal wind in any direction was felt on the surface; but it would be wrong to call it a calm. I was at the time in the centre of a strong ascending current; light substances, such as soap bubbles especially, showed this current to be of a surprising velocity; *calms* of this form are the very generators of storm.

Even when the clouds appeared to be but a mile distant the approaching of the thunderstorm was not yet felt by the springing up of wind, but, above all, by a rapid depression of temperature—this only being followed occasionally by whirlwinds comparatively mild.

[1] Hindostani for "genuine, solid, correct."—Such local storms considerably differ, nevertheless, from the typhoons in extent and power.

The outbreak of the storm begins with a most furious gust of wind, which, though of short duration, often attains a power equal to that of the wildest hurricane, blowing down native huts, unroofing even tolerably good bungalows, and tearing up, in the case I witnessed, large trees—Síssus and Tīks—along the sandy shores of the Mégna. The obscurity succeeding sunset within a few minutes appeared perfect, as it was only interrupted by flashes of vivid lightning,[1] accompanied by loud bursts of thunder. Also the rain was heavy; I had on the deck of my boat, in a rapidly constructed ombrometer[2] 0·4 inches within thirty-five minutes. At almost the very height of the storm a dissolution of the clouds suddenly succeeds, and but a few detached parts remain, only to be blown away by the last gusts of wind; a perfect calm follows—now no more a disguised ascending current—accompanied by a most surprising and delightful freshness of the atmosphere. Such "north-westers" are generally succeeded by two or three days of south-easterly winds.

During the *hot season* the temperature remains somewhat moderated by the evaporation from the surface of the many branches of the delta. Rains accompanied by thunderstorms and even hail begin already in April, and may continue occasionally till October. In 1855, I had, when in the Khássia Hills, clear dry weather from the 20th September: frequent rains of long duration began again for the eastern part of Bengál as far down as Barrackpúr from the 8th to 19th of October; the total amount of precipitation, however, is not greatest here but higher up the country, when approaching the hilly regions.

The *rainy season* on an average only fully sets in about the middle of June: in 1855 the first regular day of the breaking up of the hot season at Calcutta was as late as the 27th of June; the quantity of the water discharged by the rivers over Bengál is not alone the effect of its cloudy sky, but for the most part it rushes down over the flats from greater distances, from the Himalayan borders.

In *autumn* then, even from the middle of July till the beginning of November, the

[1] The form of the lightning is generally that of a broad stream apparently diffusing light in every direction. Compare the very different forms of flashes of lightening in the Síkkim-Himálaya, I described in the *Comptes rendus* of the French Academy, August, 1857. The details about Electricity will be given in Vol. V.

[2] The vessel I exposed was a cooking pot, well secured on the deck and deep enough to prevent the water from being blown out again by the wind. The vertical height of the rain was afterwards easily ascertained by measuring in a graduated cylinder the cubic quantity, and dividing it by the number of square inches which the opening of the vessel presented.

whole country from Fărídpurto to the east, over a distance of 40 miles, and from Bigrámpur in the south to Jaffergắnj, and farther on, in a north-westerly line of about 100 miles in length, the country is overflowed. The course of the rivers in many districts can only be traced by the trees along their banks. When crossing over, in September 1855, from the foot of the Síkkim-Himálaya to Sílhĕt, I could sail right across the country; and during the last six days before reaching Dháka I only met with artificial mounds of earth of the smallest description with two or three huts upon them. The larger villages, also, though their places are generally better selected, are mostly built on spots slightly raised artificially.—The character of the climate of Eastern Bengál is found to change but little on approaching the very borders of the Gangetic delta and the shores of the bay.

In the western parts of Bengál, approaching Hindostán, the moisture of the regions less distant from the sea-shore becomes somewhat reduced, and the dryness of the north-west wind is as yet scarcely felt; for a great part of the year such places as Tirhút are delightful, to the European as well as to the native constitution.

During the *cool season*, in general from November till February, the temperature is mild enough, the action of the direct rays of the sun in the afternoon nevertheless powerfully reminds one of the low latitude; the grass is not withered up. The nights are generally cool; and morning fogs or heavy dews make the low temperature sometimes more felt than might be expected. The Europeans occasionally have fires in their houses and wear warm clothing; flannel should be worn at all seasons. The natives, unprotected, and by their nature more sensible to the influence of cold, often suffer considerably. I had my servants sometimes shivering and benumbed all night and even a part of the morning. From October already till February east winds prevail, which take a more northerly direction towards the end of the season.

From the middle of February the wind becomes westerly; the weather is dry, the sky often cloudless for days. This may be considered the beginning of the *hot season*, but till about the middle of March the temperature is still pleasant enough. Then follow about four to six weeks of very hot weather with strong west winds, which, however, neither by their dryness nor by their power can be compared with the hot winds of the upper provinces.

Squalls from the north-west, with thunder, rain and hail,[1] are also not unfrequent.

Altogether the hot season, even as high up as Pátna, is not quite so constant as might perhaps be expected. In 1855 they had at Pátna in the middle of May alternations of east and west winds equally strong, the one refreshing, the other dry, heavy, and hot. Weather so variable is unhealthy at any season; at Pátna cholera was somewhat violent at the time.

The *rains* differ little in duration from those in the Gangetic delta, and in Eastern Bengál; considerable interruptions are not unfrequent. The rain most commonly comes from the east, but towards the end of this season there are pretty often light southerly winds, alternating perhaps with calms, which increase the heat, and the nights then are very close and suffocating.

In *autumn*, too, in favourable seasons, a heavy rain of some days is expected about the middle of October and the middle of November; if this fails the crop of rice is considerably reduced.[2] The temperature rapidly decreases, and early in the season already refreshing mornings can be enjoyed in the middle of the most perfect type of tropical vegetation, still untouched by the approach of the cool season.

Among the elevated stations of Bengál only Hazaribágh is high enough to be decidedly cooler in every season, though the plateau on which it lies extends far away in every direction. Its climate, also, in reference to moisture, miasmas and exhausting power of wind, is good; in the last statistical military Reports[3] it is compared with Raulpíndi and even with Símla.

The elevation of the stations of *Bahár*—all of them being situated on a ground very gradually rising—is not sufficient to cause a very appreciable change in the climate.

The summit of Parisnáth, the mount of the sacred foot-prints, had recently been taken into consideration for sanitary purposes; but the ridge presents so small a surface that the general opinion is now against its being fit for the erection of a sanitarium.

[1] The size of the hailstones is often described as *enormous*. They are indeed larger than ever seen in Europe; but I also had several instances where natives showed me conglomerates of hail stones frozen together, which, unacquainted with the properties of ice, they had mistaken for a single stone. See for details the following part of the meteorological researches, "On Atmospheric Moisture."

[2] The "Geographical, statistical, and historical Description of Dainajpur," by Dr. Francis Buchanan (Hamilton), contains various observations illustrating the climatological and agricultural character of these regions.

[3] Parl. San. Rep., Vol. II., p. 69.

Its height is 4,469 feet and it is the highest spot in the tropical regions drained by the Ganges or the Indus.

HEALTHINESS. Calcutta, besides its extensive and detailed series of numerical meteorological data, deserves, also in this regard, our special attention, that, notwithstanding the antipathy of the Indian Government to a census and a compulsory system of registry, it presents some materials at least for practically solving the question of *healthiness*—a question more important for the capital of the Indian empire than for any other place. Besides, general laws like these vary but little all over India. Dr. MACPHERSON, whom I have so often had occasion to mention in connexion with my meteorological data, has also collected, with the care distinguishing all his works, whatever positive materials could be obtained, at least in reference to the European population. The following data I took from various communications in the Indian Press, chiefly following those given in the *Friend of India* of 1862.

Where Europeans congregate in the East masses of natives will gather round them as a centre, and with the rapidity which attends all growth in the tropics, cities will spring up in a few years. Thus has Háurah grown. All the appliances, all the sanitary precautions of large cities in colder climates, become necessary to a degree which even the dwellers on the Thames at London cannot understand. If these appliances are only partially enjoyed, and these precautions are altogether wanting in the Indian Presidency cities, as they so lamentably are, great mortality must necessarily follow. But that this mortality has been much exaggerated would seem to be proved by general considerations as well as vital statistics. The European residents in the three cities have advantages—some call them luxuries—which neutralise the evils of the climate. Lofty houses; the very best kinds of food and drink; sufficient work and some exercise; freedom from violent excitement; ice, punkahs, and troops of servants; the first medical skill; healthy exercise of the mind and frequent changes from place to place—all give Anglo-Indians an amount of moderate enjoyment and therefore of health very different from the life they are supposed by people at home to lead. And in spite of the growing European population in the three cities, and of the consequent greater absence of sanitary advantages, the health of the European in India is decidedly improving. This gratifying result is chiefly due to the great change in moral habits which has characterised English Society in India as well as at home during the last thirty years.

When we turn to statistics we find our expectations, based on such general considerations as these, fully realised. The results of Dr. MACPHERSON, so far as they refer to Europeans, are unimpeachable, for he has confined himself to the registers of mortality of the various Protestant churches in the city. These books have been kept with great care, and include the deaths of much the largest proportion of the really European population of Calcutta. At the outset we are met by the fact that there is a large floating English population in the city, consisting of sailors, discharged soldiers, and others who live in poverty, vice, or crime, and find a premature grave. The proportion they bear to the residents is small, yet one-half of the whole mortality is among them, and even 76 in every 100 Europeans who die of cholera belong to this class. The enormous increase in the English population of Calcutta in the last ten years is a patent fact, in spite of the want of a census. Yet we find that while in the ten years ending 1850 the number of deaths registered was 3,828, in the subsequent decade it was only 4,893. But on analysing these last figures it appears that the increase of 1,065 occurred almost entirely in the last five years, and had reference to the floating population only, among whom the deaths rose from 980 to 2,195, chiefly increased by the deaths of the discharged men whom the breaking up of the naval brigades and the strike of the local army in 1858-59 threw upon society. The number of deaths among the resident Protestant population was less in 1850-60 than in 1840-50, though the number of the residents was fully one-half more. In the first decade the deaths were 2,848, in the second 2,698. Could there be a stronger testimony to the improved and improving conditions of life in Calcutta, in spite of the want of good water and drainage, than this? Dr. MACPHERSON finds the causes in the greater absence of excess in living, in the better means of preserving health enjoyed by all classes, in the facilities for removing invalids to a better climate, and in the habit of sending children home at an earlier age than before. There can be no doubt, too, that the proportion of East Indians—the race of a mixed European and native origin, and a race that does not visit Europe—is diminishing. At the top, from intermarriage, they are gradually refined away into Europeans. They are not recruited, as in the olden days, from outside; and statistics, we believe, will show that the tendency of such a race everywhere is to die out.

When we turn to details we stumble on many interesting facts of great practical value. The same years that are fatal to natives are fatal to Europeans. Of the

decade from 1840 to 1850 the year 1845 was the most unfavourable to life, and of the next decade 1858. In the last there were 590 deaths, while in 1851 there were only 375. It is found that the conditions which make an unhealthy year are when the temperature is higher than usual, when the rains are late in setting in, when the fall of rain exceeds the average quantity or comes short of it by more than a few inches, or when several months pass without any rain at all.

The beginning of the rains, I may be allowed to add, is, from my own experience destructive, in addition to the heat, by the malaria then produced;[1] in the very height of the rains, from the moisture being more uniformly spread, evaporation and decomposition of the organic parts of the soil is diminished, and the breaking up of the heat as such is also one more of the modifications in favour of less unhealthiness.

In May, April, and March the largest proportion of deaths occurs. May is most destructive to the floating population, the cause being found in exposure to the sun; while April is most fatal to the residents and also to the natives, for reasons at present unknown. Of all the deaths in the twenty years among residents, nearly 45 per cent. were females, a fact which shows a higher rate of mortality among that sex, since the proportion of males to females is probably as three to one. Strange to say, fewest females died in April, May, and August, although the two first are months of the greatest absolute mortality. Most died in January, February, and March. Turning to the causes of death among the Protestants in Calcutta, the only class of inhabitants for whom numerical data of sufficient accuracy could be collected, we find cholera to be the author of one-fourth of the whole mortality, two-thirds of which, however, was among the floating population. Dysentery and diarrhœa come next. After these in order come fever, brain diseases, lung diseases; and lastly, strange to say, liver disease, which, among soldiers, occurs most frequently in men who have been from seven to fourteen years in India, and in Calcutta generally happens "in persons who have been some years resident, and who are perfectly temperate in their habits; the disease in such cases usually making its approaches in the most insidious form." Liver and brain diseases and cholera are most fatal to males; lung diseases, fevers, and bowel complaints to females. In the five years ending 1860

[1] In the environs of Calcutta it is particularly Flagstreet and the river bank, where ships are moored, which I found in the worst condition. In 1862, as I hear, nothing had as yet been done to improve these localities.

there were only 20 deaths in childbed, an average slightly higher than in England. Quinine, which cost sixpence a grain in India in 1826, has much diminished fever. Cholera is worst in May and least dangerous in September. Bowel complaints are worst in the rains and least virulent in the cold season. Fevers occur most frequently in the very hot months and least often in March. The general result is that, during twenty years, of every 100 Protestants who died in Calcutta 28 died in the cold, 33 in the rainy, and 39 in the hot season, a fact which removes the common impression that the rainy season is the most deadly. As I mentioned above, it is the latter part of the rainy season — in fact, of the months it is September — which shows the fewest deaths, and that is a period when Europeans take the most gloomy view of life, the rains having disordered the digestive organs. As to age, 1 in $10^1/_2$ deaths occurred in the first year of life; and 1 in 7 in the first two years, when there are most living children in Calcutta. From 2 to 15 years the ratio is small, but from 15 to 20 it is $5^1/_3$; between 20 and 30 it is $22^1/_2$; and between 30 and 40 the highest point is reached, or $24^1/_2$ per cent.: that is, one-fourth of all deaths among Europeans occurs between the ages of thirty and forty, the majority of residents being at that period of life.

These statistical notes may be concluded by some data about the number of suicides committed by natives between the years 1851 to 1862 included.

Their number was 275 in Calcutta, and 199 in Bombay. In the former city hanging is resorted to most frequently, next comes poisoning, then throat-cutting; in Bombay drowning is most frequent, and then poisoning.—Most suicides occur in the rainy season.[1]

Along the shores of the sacred rivers, I must add, I had occasion to observe hundreds of cases where a species of suicide was committed, though unconsciously, by sick Hindus insisting upon being carried out, not too late, to expire on the shore of the sacred river, where even their feet must be washed by the sacred stream before the corpse is thrown into it.

For the *absolute extremes* as well as for the *mean insolation* the observations at Calcutta were the best I could select; for the purpose of showing the influence exercised at Calcutta by moisture on the heat attained by the insolated thermometer I also added Benáres, from the observations of Dr. Gibbon.

[1] In France the most numerous cases of suicide are those by drowning, then those by fire-arms; while not one Bengalee suicide used fire-arms.

Absolute extremes at Calcutta,

selected from the Records of the Government Observatory.[1]

Months.	Extremes.		Months.	Extremes.	
	Min.	Max.		Min.	Max.
January	49	78	July	74	98
February	52	81	August	76	92
March	61	90	September . . .	72	92
April	69	95	October	70	90
May	74	106	November	59	87
June	75	105	December	51	80

Mean Insolation

for Calcutta, 1855 to 1859; Benáres for 1858 and 1859.

Months.	Calcutta.	Benáres.	Months.	Calcutta.	Benáres.
January	130	90	July	133	116
February	132	97	August	126	110
March	135	102	September . . .	136	114
April	135	118	October	136	116
May	134	127	November	129	109
June	133	114	December	124	92

Plates to be compared:

The Jhils of Bengál, at high water. Part IV., No. 22.

The Mahanåddi river at Kasiabári in the rainy season. Part IV., No. 23.

Western Bengál, near Pátna, after the subsidence of the waters in the bed of the Ganges. Part IV., No. 24.

General view of the Plains from the Summit of Parisnáth, in Bahár, in March. Part III., No. 19.

[1] For detail of the register see p. 202.

BĀKÚRA, in Bengál.

Latitude North.	Longitude East Green.	Height.
23° 14′·8	87° 3′·1 ♁	L.a.L.S.

1851, Journ. As. Soc. for 1852. Was left out, as decidedly too warm.
1852-5, CHUTE, 1852 and 1853; SR.; Noon; SS.—1854: SR.; 10; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 12.

Months.	1852			1853			1854			General mean.
	SR.	Noon.	Mean of the month.	SR.	Noon.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	62·0	67·0	64·5	....	....	....	....	....	....	63·0
February	74·0	83·3	78·6	66·0	78·3	72·1	59·1	76·0	67·5	72·7
March	....	....	....	75·8	84·3	80·0	69·5	89·5	79·5	79·7
April	....	....	....	82·0	89·1	85·5	....	....	....	(85·5)
May	85·6	90·3	87·9	....	....	....	....	....	....	(87·9)
June	87·3	93·4	90·3	83·2	88·0	85·6	80·7	90·5	85·6	87·2
July	82·0	87·1	84·5	81·8	86·0	83·9	80·0	88·5	84·2	84·2
August	85·1	86·9	86·0	81·7	87·0	84·3	80·2	84·8	82·5	84·3
September	83·2	86·1	84·6	81·0	82·2	81·6	77·9	81·1	79·5	81·9
October	....	....	....	....	....	....	....	....	(74·4)	(74·4)
November	65·3	76·0	70·6	66·0	77·5	71·7	62·8	75·8	69·3	70·5
December	....	....	....	....	....	....	55·0	71·5	63·2	(63·2)
Year			....			....				78·0

Isolated month (mean). 1855: Jan. 61·6.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·3	84·4	85·2	75·6	78·0

BĂRDVÁN (East), in Bahár.

Latitude North.	Longitude East Green.	Height.
23° 13′·2	87° 48′·9 ♁	93 feet

1851. Journ. As. Soc.
1854. HARDING, SR.; 10; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 12.

Months.	1851	1854			General mean.
	Mean of the month.	SR.	4^h.	Mean of the month.	
January	70·5	63·5	72·8	68·1	66·6
February	76·5	67·0	74·8	70·9	73·7
March	83·0	75·5	83·5	79·5	81·2
April	86·0	....	....	....	(86·0)
May	90·0	....	....	....	(90·0)
June	88·5	82·7	86·6	84·6	86·5
July	85·0	83·4	87·5	85·4	85·2
August	86·8	82·2	86·1	84·1	85·4
September	87·2	82·0	85·1	83·5	85·3
October	82·0	....	....	....	(82·0)
November	73·0	71·2	75·4	73·3	73·1
December	(71·0)	65·3	70·1	67·7	69·3
Year	81·6			....	80·4

Isolated month (mean). 1855: Jan. 64·1.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
69·9	85·7	85·7	80·1	80·4

Barisál, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 35′·7	90° 13′·65	L.a.L.S.

1852-4. McKaylay, SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 18.

1856. Journ. As. Soc. excluded, the values given there being from March to Nov. much too hot.

Months.	1852 SR.	1852 4h P.M.	1852 Mean of the month.	1853 SR.	1853 4h P.M.	1853 Mean of the month.	1854 SR.	1854 4h P.M.	1854 Mean of the month.	General mean.
January	55·3	72·5	63·9	58·0	68·4	63·2	56·9	73·4	65·1	64·1
February	65·5	81·5	73·5	65·1	75·6	70·3	59·1	73·5	66·3	70·0
March	69·2	83·2	76·2	74·2	84·6	79·4	71·9	86·2	79·0	72·2
April	78·2	88·0	83·1	79·4	88·0	83·7	75·8	83·3	74·5	80·4
May	80·2	87·0	83·6	82·5	90·1	86·3	80·6	88·2	84·4	84·8
June	80·5	84·2	82·3	....	....	....	79·6	83·0	81·3	81·8
July	78·2	81·5	79·8	81·0	84·1	82·5	....	....	....	81·1
August	80·1	83·9	82·0	80·1	84·8	82·4	78·9	83·0	80·9	81·8
September	80·8	84·8	82·8	80·1	83·8	81·9	80·2	85·6	82·9	81·9
October	77·8	83·7	80·7	....	....	....	76·6	87·4	82·0	81·3
November	67·8	76·3	72·0	68·1	79·4	73·7	67·5	78·5	73·0	72·9
December	61·7	70·5	66·1	55·8	72·5	64·1	58·3	71·9	65·1	65·1
Year		1852: 77·2				....			....	76·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·4	79·1	81·6	78·7	76·4

Barrakpúr, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 42′·6	88° 21′·8ƀ	L. a. L. S.

1851. Journ. As. Soc. 1842, decidedly much too hot; I excluded it.
1852 and 1854. Thompson, Wallich, SR.; 2; 10; 4; SS. and SR.; 10; 4; 10.

Months.	1852			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	59·6	79·6	69·6	56·9	74·6	65·7	67·6
February	69·2	73·5	71·3	58·2	77·0	67·6	69·4
March	72·5	84·3	78·4	73·0	88·3	80·6	79·5
April	81·5	90·8	86·1	....	....	....	(86·1)
May	79·0	88·5	83·7	....	....	....	(83·7)
June	83·8	87·0	85·4	81·8	87·9	84·8	85·1
July	81·4	84·1	82·7	79·1	88·8	83·9	83·3
August	81·8	84·0	82·9	81·2	86·4	83·8	83·3
September	82·1	85·7	83·9	81·4	83·3	82·3	83·1
October	....	....	(80·2)	....	....	....	(80·2)
November	71·0	76·5	73·7	71·1	76·7	73·8	73·7
December			....	68·8	70·6	69·7	(69·7)
Year			....			....	78·7

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
69·6	83·1	83·9	79·0	78·7

Bérhampur, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 5′	88° 14′	79 feet

1857-9. Guise. Mean of extremes. Parl. San. Rep., Vol. II., p. 50. The height is referred to the high-water-mark of the Bhagirátti river; the station is 3 feet below it.

1857 to 1859.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	51	76	63·5	July	76	92	84
February	54	82	68	August	77	90	83·5
March	61	91	76	September	78	91	84·5
April	69	98	83·5	October	70	88	79
May	71	99	85	November	60	81	70·5
June	77	100	88·5	December	55	75	65

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·5	81·5	85·3	78	77·5

Bhāgalpúr, in Bahár.

Latitude North.	Longitude East Green.	Height.
25° 18′·8	86° 56′·6 ♁	154 feet

1851. Journal As. Soc., 1852, Means.
1852-4. Allen, only means communicated.

Months.	1851	1852	1853	1854	General mean.
	Means of the month.				
January	66¾	65	54	66	62·6
February	72½	76	76	69	73·4
March	80	78	..	78	78·6
April	86½	89	98	86	89·9
May	92½	93	94	89	92·1
June	90½	89	87	85	87·9
July	87	86	84	86	85·7
August	85⅔	81	..	81	82·5
September	85	85	..	82	84·0
October	82	73	76	79	77·5
November	72	65	73	68	69·5
December	66½	56	65	65	63·1
Year	80·5	78·0	..	77·8	78·9

Isolated month (mean). 1855: Jan. 62.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·4	86·9	85·4	77·0	78·9

Birbhúm (Súri), in Bengál.

Latitude North.	Longitude East Green.	Height.
23° 54′·4	87° 30′·6ꝫ	L.a.L.S.

1851-4. Sheridan. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 11.

Months.	1851			1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	64·5	71·3	67·9	63·3	70·4	66·8	....	....	....	61·4	71·6	66·5	67·1
February	69·0	75·8	72·4	70·3	80·2	75·2	67·9	78·3	73·1	67·1	75·0	71·0	72·9
March	78·9	87·4	83·1	75·6	81·7	78·6	78·4	87·6	83·0	76·9	82·2	79·5	81·0
April	82·4	90·2	86·3	82·8	90·4	86·6	....	....	....	83·0	91·0	87·0	86·6
May	89·6	98·1	93·8	84·4	89·9	87·1	....	....	....	84·0	90·5	87·2	89·3
June	86·1	89·9	88·0	85·3	87·6	86·4	85·8	91·9	88·8	81·8	85·0	83·4	86·6
July	83·1	86·1	84·6	81·2	83·1	82·1	83·6	84·6	84·1	84·1	86·5	85·3	84·0
August	83·9	87·1	85·5	83·4	85·0	84·2	80·2	84·7	82·4	82·1	83·7	82·9	83·7
September	84·2	87·5	85·8	82·2	84·1	83·1	82·5	84·6	83·5	81·7	83·8	82·7	83·8
October	81·3	83·7	82·5	79·7	84·8	82·2	71·3	78·1	74·7	79·9	83·2	81·5	80·2
November	71·7	77·7	74·7	70·2	76·8	73·5	....	....	....	68·7	77·3	73·0	73·7
December	67·1	72·8	69·9	....	....	(68)	....	....	....	60·0	75·1	67·5	68·5
Year	1851: 81·2			1852: 79·5					....	1854: 79·0			79·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
69·5	85·6	84·8	79·2	79·8

Bógra, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 50′	89° 22′	L.a.L.S.

1854. Taylor. SR.; 10; 4; 10.

Schlagintweit, "Met. Mscr.," Vol. 18.

1851 from the Asiatic Journal left out, being much too warm in the hot season.

1854							
Months.	SR.	4^h P.M.	Mean of the month.	Months.	SR.	4^h P.M.	Mean of the month.
January	53·2	74·4	63·8	July	81·0	86·1	83·5
February	55·5	74·1	64·8	August	79·2	84·8	82·0
March	62·9	85·2	74·0	September	79·3	85·6	82·4
April	70·4	85·5	77·9	October	73·5	83·1	78·3
May.	76·2	89·7	82·9	November	63·7	78·6	71·1
June	78·4	84·2	81·3	December	55·1	73·5	64·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·3	78·3	82·3	77·3	75·5

CALCUTTA, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 33′·0	88° 20′·6$\frac{5}{6}$	18 feet.

A. 1816-23, the oldest series of observations by HARDWICKE is communicated in the Transactions of the Royal Asiat. Society, Vol. II., 1829, Appendix. The resulting means are too warm; they could not be subjected to examination and recalculation.

B. 1st Part. 1829, 30, 31, 33, and 34 in the Surveyor General's office, Chauríngi. Hours of observation: SR., 10, 12, 4, SS.; partly also 3^h 30^m P.M. and Max. In Gleanings in Science and Journ. As. Soc.

2nd Part. For the years 1833, 34, and for 1836, 37, 38, down to May 1839, the Journal of the Asiatic Society also contains observations made in an open verandah of the Assay office. I add the means as I found them communicated in the respective parts of the Journal; but it will be easy to see that, compared with the other results, the temperature is decidedly too warm, most probably owing to the circumstance that these means are deduced from a series of hours most of which belonged to periods of the day considerably above the mean of the 24 hours. These values are not included in the "General Means," p. 205.

For 1838 to 40 I could not procure myself observations extended over the entire yearly period. The Journal As. Soc. for 1839 and 40, and the Journal Nat. Hist., Vol. II., &c., contain some numbers for 1839: June to October, and December; for 1840: January, February; April, May, August to December.

C. For the period 1841 to 1850 the Journal of the As. Soc. contains in 1851, a very careful *résumé* of the observations made at SR. 9^h 50^m A.M., 2^h 40^m P.M., 4^h P.M. and SS.; but the means I give in the following table are those calculated by myself by combining $\frac{\text{SR. and } 4^h \text{ A.M.}}{2}$.

D. 1851-8. The observations at the Surveyor General's office were made during the first part of this period at the hours of SR. (Min.), 9^h 50^m A.M., 2^h 40^m P.M., 4^h P.M., SS.; from 1853 hourly observations are communicated in the Journal of the Asiatic Society of Bengál. Also the Journal of the Agricultural Society of India contains meteorological observation for the last decennium. But in selecting the materials for this volume I preferred limiting myself to the communications made from the Surveyor General's office to the Asiatic Society, and published then with the greatest care and regularity. From the year 1853 the monthly means are from hourly observations. The means are only calculated in full detail in the communications made to the Asiatic Society since 1856.

1st Period.

Months.	1816.	1817.	1818.	1819.	1820.	1821.	1822.	1823.	Mean.
January	.....	66·23	65·44	60·49	58·91	66·53	70·66	68·22	65·21
February	.....	68·34	70·01	67·52	65·28	73·22	75·68	74·33	70·62
March	79·39	74·55	75·16	78·55	77·12	78·23	82·74	78·73	78·05
April	82·07	84·24	81·66	80·24	82·61	85·00	82·99	87·49	83·28
May	86·53	83·12	85·10	84·09	85·11	86·12	87·63	86·10	85·47
June	86·18	82·56	83·34	83·63	83·99	87·31	85·49	85·02	84·69
July	81·75	82·42	81·01	82·53	82·76	84·22	84·07	82·20	82·61
August	82·92	82·97	82·49	82·20	83·60	83·65	83·34	81·93	82·88
September	81·79	82·45	80·18	82·56	83·75	82·68	83·91	81·99	82·41
October	80·09	81·33	80·57	80·23	81·14	80·94	80·73	82·85	80·98
November	71·69	74·14	71·76	73·96	74·04	75·47	73·51	73·17	73·46
December	65·65	67·00	65·45	64·81	65·96	69·11	67·53	.....	66·50
Year	.....	77·45	76·85	76·73	77·02	79·37	79·86	.....	78·01

General mean of the year: 78·01

2nd Period, 1st Part.

Months.	1829			1830			1831			1833			1834		
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.
January	....	....	....	53·3	75·3	64·2	57·8	77·5	67·6	61·1	72·4	66·7	58·9	71·1	65·0
February	....	....	....	65·2	84·4	74·8	65·2	77·8	71·5	67·5	78·7	73·1	66·5	77·8	72·1
March	....	....	....	75·7	84·5	80·1	70·3	86·7	78·5	75·7	89·2	82·4	75·0	86·7	80·8
April	79·4	92·3	85·8	75·7	88·5	82·1	74·9	90·8	82·8	78·8	91·6	85·2	77·2	93·2	85·2
May	80·6	91·3	85·9	77·7	88·9	83·3	81·5	94·1	87·8	80·8	90·0	85·4	83·1	94·6	88·8
June	80·1	87·1	83·6	80·1	85·9	83·0	81·3	87·6	84·4	84·3	92·8	88·5	81·8	87·8	84·3
July	79·3	84·3	81·8	79·3	83·9	81·6	82·2	78·2	84·2	81·3	87·9	84·6	81·5	88·0	84·2
August	79·0	84·7	81·8	79·1	84·6	81·6	80·2	84·0	82·1	81·0	86·6	83·8	81·4	86·7	84·0
September	79·7	85·6	82·6	78·7	84·9	81·6	79·3	83·5	81·4	81·1	88·3	84·7	81·2	86·4	83·8
October	75·5	82·5	79·0	77·3	84·3	80·8	78·4	85·5	81·9	78·8	86·8	82·8	78·9	83·9	81·4
November	68·8	79·7	74·2	66·7	78·5	72·6	64·6	77·9	71·2	70·3	82·1	76·2	71·7	79·4	75·5
December	....	....	....	58·1	76·2	67·1	62·3	75·0	68·6	63·0	74·3	68·6	66·1	75·7	70·9

2nd Period, 2nd Part.

Months.	1833.	1834.	1835.	1836.	Mean.
January	71·2	69·3	69·25	67·35	69·28
February	76·35	75·9	75·45	72·7	75·13
March	86·35	84·5	81·7	81·5	83·51
April	89·55	89·85	87·75	88·45	88·89
May	88·75	92·65	87·55	92·6	90·39
June	91·65	87·4	86·75	88·8	88·65
July	87·1	87·3	84·0	85·15	85·89
August	85·9	85·9	84·0	86·65	85·61
September	87·3	86·15	84·35	86·4	86·05
October	86·0	83·4	84·2	84·05	84·41
November	80·55	79·3	76·75	78·3	78·73
December	73·0	74·05	70·09	72·3	72·36
Year	83·64	82·98	80·99	82·02	82·41

General mean of the year: 82·41.

3rd Period, means from 1841 to 1850.

Months.	SR.	4^h P.M.	Mean.	Months.	SR.	9^h P.M.	Mean.
January	59·6	69·1	64·35	July	80·6	83·5	82·05
February	64·2	73·8	69·00	August	80·3	86·0	83·15
March	72·3	81·2	76·75	September	80·3	86·5	83·40
April	78·3	85·8	82·05	October	76·7	86·0	81·35
May	80·3	86·4	83·35	November	67·5	84·8	76·15
June	80·9	84·3	82·60	December	60·0	76·7	68·35

General means: SR. 73·4; 4^h P.M., 82·0; Year: 77·80.

4th Period.

Months.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	Mean.
January	67·9	66·4	66·4	67·3	66·5	68·6	68·0	68·1	67·40
February	73·0	76·8	73·4	71·1	72·1	72·7	75·0	71·0	73·14
March	82·5	78·7	82·2	81·2	79·3	80·2	80·5	81·3	80·74
April	85·7	85·8	86·3	83·9	82·3	85·8	83·2	86·2	84·90
May	90·1	86·6	89·0	86·8	85·9	85·0	86·0	86·0	86·92
June	84·9	85·5	86·2	84·1	85·6	83·3	85·3	86·9	85·22
July	83·2	82·5	84·1	83·5	82·3	83·2	82·2	83·8	83·10
August	84·5	83·0	83·4	83·0	83·7	82·4	82·0	83·6	83·20
September	85·0	83·6	84·0	82·3	82·3	83·4	82·5	83·9	83·37
October	81·1	83·5	82·1	80·5	81·2	81·0	81·6	81·3	81·54
November	75·2	(74·5)	75·4	74·3	74·4	75·2	73·0	73·8	74·47
December	67·8	(67·6)	67·0	68·6	66·9	68·5	67·4	66·7	67·56
Year	80·1	79·4	79·9	78·9	78·5	79·0	78·6	79·4	79·21

General means, based upon the thirty years:
1816—23, 1830—34, 1841—50, 1851—58.

Months.		Months.	
January	65·60	July	82·69
February	71·06	August	83·05
March	77·99	September	83·06
April	83·37	October	81·35
May	85·37	November	74·68
June	84·18	December	67·70

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
68·12	82·24	83·31	79·70	78·34

CHAIABÁSSO, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 31′·7	85° 42′·8♁	L.a.L.S.

1852-4. (Observer's name not legible) SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 11.

Months.	1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	....	....	....	58·8	67·8	63·3	58·2	69·6	63·9	63·6
February	....	....	....	65·3	81·3	73·3	63·7	73·5	68·6	70·9
March	....	....	....	74·3	90·7	82·5	71·6	81·9	76·7	79·6
April	....	....	....	80·7	90·0	85·3	82·4	91·3	86·8	86·0
May	....	....	....	83·7	94·9	89·3	85·4	90·6	88·0	88·6
June	....	....	....	83·7	89·4	86·5	84·8	88·1	86·4	86·4
July	....	....	....	81·1	83·3	82·2	82·0	84·9	83·4	82·8
August	77·6	84·5	81·0	80·8	83·8	82·3	80·0	82·7	81·3	81·5
September	78·8	86·2	82·5	78·9	83·1	81·0	79·4	81·7	80·5	81·3
October	74·4	83·7	79·0	74·7	79·5	77·1	76·7	79·2	77·9	78·0
November	63·7	78·7	70·7	66·4	77·6	72·0	69·7	73·9	71·8	71·5
December	....	....	....	58·4	69·2	63·8	63·3	69·1	66·2	65·0
Year			....	for 1853: 78·2			for 1854: 78·5			78·2

Isolated month (mean). 1855: Jan. 63·8.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·5	84·7	83·6	76·9	77·9

Chandernagúr, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 50′	88° 23′	46 feet.

Monthly means deduced from observations at 8^h A.M., Noon, 4^h P.M. This combination makes it decidedly too warm, particularly for the hot and the rainy seasons, as is seen by a comparison with Calcutta, Barákpur, &c. In order, however, to complete the materials, I have taken it as I found it in Dove's "Nichtperiodische Aenderungen der Temperaturvertheilung," IV., Berl. Acad. for 1858, publ. 1859. He quotes for the original publication Annuaire de la Société météorol. de la France, II., p. 136.

Approximate monthly means.

Months.		Months.	
January	60·8	July	86·8
February	68·8	August	87·2
March	77·3	September	83·7
April	88·2	October	79·7
May	93·7!	November	72·7
June	94·2!	December	63·7

Approximate mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·4	86·4	89·4	78·7	79·7

Chápra (Sárun), in Bengál.

Latitude North.	Longitude East Green.	Height.
26° 45′·5	85° 25′·8 ♁	Ab. 250 feet

1851-6, Simpson; Flemming, 1851-3, Means of Extremes, already calculated. 1854-6, SR; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 14.

Months.	1851	1852	1853	1854			1856			General mean.
	Means of the month.			SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	....	59·2	57·6	53·7	67·9	60·8	54·7	68·1	61·4	59·7
February	....	69·7	66·5	52·7	80·4	66·5	57·1	73·5	65·3	67·0
March	75	73·5	78·4	63·4	83·8	73·6	71·3	81·3	76·3	75·4
April	92	84·7	84·7	75·9	96·4	86·1	73·9	95·2	84·5	86·4
May	93	87·2	....	80·4	99·9	90·1	80·6	95·7	88·1	89·6
June	89½	89·1	....	80·8	89·7	85·2	78·5	82·5	80·5	86·1
July	86	83·0	....	82·3	90·4	86·3	81·9	88·4	85·1	85·1
August	....	84·6	85·0	81·0	86·1	83·5	80·7	86·7	83·7	84·2
September	83	80·7	63·0	80·2	86·2	83·2	81·0	86·8	83·9	78·8
October	80	79·0	....	74·2	84·5	79·3	74·9	81·7	78·3	79·1
November	63	68·2	....	63·5	75·6	69·5	68·3	78·7	73·5	68·5
December	59	60·0	....	....	68·7	....	55·0	67·1	61·0	60·0
Year	....	76·6	....			....	for 1856: 76·8			76·6

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·2	83·8	85·1	75·5	76·6

CHENDVÁR HILL, near Hazaribágh, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 0′	85° 20′	2,815 feet

1860, Lt.-Col. YOUNG, in "Selections from the Records of the Gov. of Ind. Mil. Dep.," 1862, Vol. III., p. 176.

	7^h A.M.	Noon	4^h P.M.	Mean $\frac{7+4}{2}$
1860, July	72·5	72·4	72·5	72·5
„ Aug.	70·6	78·4	71·9	71·2

at Hazaribágh, 735 feet lower, the temperature was

	10^h	4^h
1860, Aug.	80·7	80·9

CHITTAGÓNG, or ISLAMABÁD, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 20′·5	91° 44′·15	191 feet

1851, Jan. to March, in Manuscript, April to Dec., Journ. As. Soc., 1852.
1850-4, CH. EVAN; WILLIAMS; BEATSON. SR.; 9^h 50^m; Noon; 2^h 40^m; 4^h; SS.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 19.

Months.	1850			1851	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	....	....	65·0	53·9	68·7	61·3	60·2	68·6	64·4	....	....	....	63·6
February	....	....	....	71·2	59·9	75·3	67·6	63·8	75·7	69·7	65·2	73·0	69·1	69·4
March	....	....	....	76·6	71·1	78·1	74·6	70·2	83·6	76·9	....	....	....	76·0
April	76·4	85·0	81·3	81·7	75·4	83·1	79·2	79·7	85·3	82·5	75·2	80·7	77·9	80·5
May	79·1	86·5	82·8	80·6	....	....	....	82·5	88·8	85·6	79·5	86·3	82·9	83·0
June	76·5	80·3	78·4	76·6	79·2	83·4	81·3	80·0	84·2	82·1	78·2	82·5	80·3	79·7
July	80·1	84·2	82·1	78·1	78·2	79·9	79·0	79·5	82·4	80·9	78·9	83·5	81·2	80·2
August	79·1	81·9	80·5	79·1	80·4	84·7	82·5	78·9	82·6	80·7	....	....	....	80·7
September	79·5	82·5	81·0	80·5	80·1	84·1	82·1	79·5	82·6	81·0	....	....	....	81·1
October	77·7	82·7	80·2	77·2	79·0	83·0	81·0	78·6	82·6	80·6	....	....	....	79·7
November	68·6	77·0	72·8	72·8	69·0	77·0	73·0	64·9	75·5	70·2	....	....	....	72·2
December	59·7	69·6	64·6	67·5	62·0	70·9	66·4	60·5	72·1	66·3	....	....	....	66·2
Year			....	75·6			....	for 1853: 76·7					....	76·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·4	79·8	80·2	77·7	76·0

Chunár, in Bahár.

Latitude North.	Longitude East Green.	Height.
25° 7′·5	82° 51′·6	250 feet

A. 1819: May to December; 1820: January to April. Edinb. Phil. Journ., 1821, p. 442. Four observations a day.

1819 and 1820. Mean of the month.			
January	58	July	90
February	62½	August	85½
March	77½	September	82¼
April	84	October	79¾
May	89	November	69½
June	88	December	63¼

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
61·2	83·5	87·8	77·2	77·4

B. 1850 to 1859. Tweddell. Mean of extremes. Parl. San. Rep., Vol. II., p. 87. I preferred introducing this recent series exclusively into my general tables.

Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	54	76	65	July	79	96	87·5
February	57	82	69·5	August	78	94	86
March	63	93	78	September	77	93	85
April	74	98	86	October	72	91	81·5
May	80	102	91	November	62	85	73·5
June	81	103	92	December	53	77	65

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·5	85	88·5	80	80

DÁINAJPUR, in Bengál.

Latitude North.	Longitude East Green.	Height.
25° 36′·6	88° 36′·8 ♉	180 feet

1854, PETER; NEWETT. Means of extremes.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 14.

The temperatures for 1851 in As. Soc. Journ. seem to be not the means of the day, but warmer.

1854, Mean of the month.			
January	63	July	83½
February	68½	August	81½
March	80	September	81½
April	87	October	80
May	90	November	72
June	80½	December	66

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66	86	81·8	77·8	77·8

DĂMDĂM, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 37′·9	88° 21′·2 ♁	L. a. L. S. (30 feet)

1852-5. Artillery lines; MARSHALL; MACKINNON; CAMDEN; DUKE. SR.; 10; 4; SS.; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 12.

Months.	1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	62·0	69·5	65·7	63·0	68·1	65·5	64·5	70·5	67·5	66·2
February	70·5	79·5	75·0	71·5	77·5	74·5	66·5	70·5	68·5	72·7
March	74·0	82·5	78·2	74·5	83·5	79·0	78·3	81·5	79·9	79·0
April	....	....	....	83·5	88·0	85·7	....	....	....	(85·7)
May	....	....	....	....	....	....	83·0	89·1	86·0	(86·0)
June	83·5	87·5	85·5	82·0	87·6	84·8	82·3	87·9	85·1	85·1
July	80·0	82·5	81·2	82·2	84·5	83·3	81·5	85·7	83·6	82·7
August	82·5	85·0	83·7	81·5	84·0	82·7	80·4	83·8	82·1	82·8
September	80·0	84·0	82·0	82·5	85·3	83·9	81·4	84·0	82·7	82·9
October	80·5	82·5	81·5	....	....	....	....	....	....	81·2
November	70·5	75·0	72·7	75·1	79·3	77·2	71·3	76·9	74·1	74·7
December	....	....	....	....	....	....	66·0	71·4	68·7	(68·7)
Year			....			....			....	79·0

Isolated month (mean). 1851: Oct. 80·9.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
69·2	83·6	83·5	79·6	79·0

DÉRI, in Bahár.

Latitude North.	Longitude East Green.	Height.
24° 55′	84° 10′	332 feet

1860. GARDNER. SR.; 10; 4; 8 or 10. Calc. San. Est., 1861, pp. 108 to 113.

	SR.	4h	Mean.		SR.	4h	Mean.
July	84	92	88	Sept.	82·6	91·2	86·9
Aug.	82	90	86				

DHÁKA, in Bengál.

Latitude North.	Longitude East Green.	Height.
23° 42′·7	90° 20′·3	72 feet

1832-6. Means of the year, based on the means of SR. and 3^h. TAYLOR, "Topography of Dakka," Calc. 1840, p. 16; but those of the single months not being given, I exclude them from the general means. They are in the respective order 74·5, 75·1, 74·7, 74·1, and 74·7.

1851. Journ. As. Soc., 1852, deduced from extremes, as Dr. GREEN told me in 1855.

1852-4. GREEN. SR.; 9^h 50^m; Noon; 2^h 40^m; 4^h; SS.; and Min.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 17.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	67·3	....	....	....	58·8	68·2	63·5	61·9	69·9	65·9	65·6
February	71·0	....	....	....	65·8	76·1	70·9	62·8	71·2	67·0	69·6
March	82·5	....	....	....	75·1	85·5	80·3	73·0	81·8	77·4	80·1
April	84·0	77·6	87·9	82·7	80·9	89·2	85·0	76·4	83·0	79·7	82·8
May	88·2	80·6	85·7	83·1	82·5	88·2	85·3	80·6	87·0	83·8	85·1
June	84·2	82·1	85·2	83·6	82·9	86·2	84·5	80·7	82·7	81·7	83·5
July	86·3	81·0	83·0	82·0	82·4	85·3	83·8	82·4	86·0	84·2	82·7
August	85·3	82·6	84·6	83·6	82·1	84·4	83·2	82·2	84·0	83·1	83·8
September	85·6	83·2	84·9	84·0	81·3	83·3	82·3	82·1	84·8	83·4	83·8
October	81·9	80·0	84·0	82·0	78·6	83·6	81·1	79·7	82·9	81·3	81·6
November	75·7	69·0	76·9	72·9	70·1	77·3	73·7	71·9	76·4	84·1	74·1
December	69·5	61·8	71·2	66·5	62·8	70·6	66·7	65·2	70·8	68·0	67·7
Year	80·1			....		for 1853: 78·4			for 1854: 77·5		78·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·6	82·7	83·3	79·8	78·4

FĂRÍDPUR, in Bengál.

Latitude North. 23° 36′·5 | Longitude East Green. 89° 48′·9 | Height. L.a.L.S.

1853 and 1854. KALACHÁND. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 18.

Months.	1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	59·4	70·5	64·9	59·4	74·1	66·7	65·8
February	64·0	78·1	71·0	63·8	75·2	69·5	70·2
March	69·9	88·9	79·4	71·2	85·8	78·5	78·9
April	78·2	89·4	83·8	74·5	85·7	80·1	81·9
May	69·4	86·5	77·9	70·3	87·9	79·1	78·5
June	80·6	85·5	83·1	79·1	83·8	81·4	82·2
July	79·6	84·5	82·0	81·1	84·6	82·8	82·4
August	80·7	84·6	82·6	80·1	83·2	81·6	82·1
September	80·5	83·1	81·8	80·5	84·4	82·4	82·1
October	77·5	83·1	80·3	77·0	82·9	79·9	80·1
November	68·7	79·6	74·1	69·1	77·9	73·5	73·8
December	59·8	73·4	66·6	62·3	73·6	67·9	67·2
Year	for 1853: 77·3			for 1854: 76·9			77·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·7	79·8	82·2	78·7	77·1

GÁYA, in Bahár.

Latitude North.	Longitude East Green.	Height.
24° 49′	85° 0′	280 feet

1852-4. DRAPER. 1851-3. SR.; 9; 50; 12; 2; 4; SS.; Minimum.
1854. SR.; 10; 4; 10.

Values for 1851 are also given in the As. Soc. Journ., 1852; but they are in many months 4° to 5° too warm, evidently since the mean of all the observations presented was indiscriminately taken.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 13.

Months.	1851			1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	54·1	72·2	63·15	56·9	74·0	65·45	54·9	68·3	61·6	54·5	72·7	63·6	63·4
Febr.	60·4	74·5	67·45	66·3	81·8	74·05	65·6	80·6	73·1	58·8	74·0	66·4	70·2
March	70·8	....	(75·8)	69·6	81·9	75·75	72·9	93·5	83·2	....	....	....	78·2
April	67·7	97·5	82·6	78·9	97·5	88·2	81·5	100·2	90·85	77·1	92·0	84·55	86·5
May	87·4	101·8	94·6	84·1	92·7	88·4	84·7	102·5	93·6	86·5	95·9	91·2	91·9
June	87·5	95·7	91·6	85·8	92·1	88·95	89·2	95·0	92·1	79·2	91·6	85·4	89·5
July	83·1	88·6	85·85	80·6	85·5	83·05	78·6	88·2	83·4	81·2	90·0	85·6	84·5
Aug.	83·3	89·6	86·45	81·7	86·0	83·85	79·5	91·7	85·6	79·7	89·9	84·8	85·2
Sept.	81·6	87·9	84·75	83·2	88·7	85·95	....	.....	.....	80·0	86·5	83·25	84·6
Oct.	77·1	86·0	81·55	78·1	83·2	80·65	74·6	85·2	79·9	77·8	87·1	82·45	81·1
Nov.	65·9	75·2	70·55	....	....	.....	67·5	80·4	73·95	65·7	76·8	71·25	71·9
Dec.	....	....	(65·2)	63·8	70·0	66·9	57·0	71·6	64·3	59·1	72·6	65·85	65·5
Year			....			.....			.....			.....	79·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·4	85·5	86·4	79·2	79·4

HAZARIBÁGH, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 0′·0	85° 20′·9	1,750 feet

1851. Journ. As. Soc., 1852.
1850-5. Native Doctor; means based on extremes.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 11.

1858-60. Means of observations in the regimental hospital; but as Dr. CAMPBELL says: "they cannot be considered of any great statistical value." Parl. San. Rep., Vol. II., p. 68. A comparison with the observations I received in detail for 1850-5 showed them to be in general considerably too warm.

Months.	Mean of the months.			General mean.	Months.	Mean of the months.			General mean.
	1850.	1851.	1854.			1850.	1851.	1854.	
January	....	62·5	60·9	60·0	July	81·9	77·9	(82·0)	80·6
February	....	63·0	62·6	65·2	August	79·1	77·4	77·7	77·5
March	....	74·1	72·9	73·5	September	77·5	75·9	76·2	76·0
April	79·1	81·7	80·7	80·5	October	73·7	71·0	73·9	72·9
May	86·5	....	83·4	84·9	November	66·4	68·0	66·1	66·8
June	80·9	....	80·3	80·6	December	60·8	62·9	62·2	62·0
					Year	....	....	73·2	73·4

Isolated months (means). 1852: Jan. 58·1; Febr. 70·0. 1855: Jan. 58·7.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·4	79·6	79·6	71·9	73·4

Húgli, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 53′·4	88° 23′·1 ♉	L. a. L. S. (30 feet)

1851. Also in Journ. As. Soc. for 1852, but here I corrected the means for hours of observation.
1854 and 1855. Haillie. SR.; $9^1/_2$; 10; N.; 3; $3^1/_2$; 4; SS.; 10.

Schlagintweit, "Met. Mscr.," Vol. 12.

The observations in general were not made very regularly at the hours indicated.

Months.	1851	1854			General mean.	Months.	1851	1854			General mean.
	Mean of the month.	SR.	4h P.M.	Mean of the month.			Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	65·0	53·7	75·4	64·5	63·4	July	81·0	79·4	81·6	80·5	80·7
Febr.	68·0	60·2	76·1	68·1	68·0	Aug.	82·0	76·4	83·3	79·8	80·9
March	80·4	69·7	89·6	79·6	80·0	Sept.	82·5	....	....	....	(82·5)
April	85·0	....	....	....	(85·0)	Oct.	80·0	....	....	....	(80·0)
May	87·0	....	....	....	(87·0)	Nov.	71·2	66·2	80·5	73·7	72·2
June	84·3	79·5	84·9	82·2	83·2	Dec.	62·5	58·8	74·7	66·7	64·6
						Year	77·4				

Isolated month (mean). 1855: Jan. 60·8.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·3	84·0	81·6	78·2	77·3

Jamíra Pat, in the Sirgújah Highlands, Bahár.

Latitude North.	Longitude East Green.	Height.
25° 0′	83° 15′	3,200 feet[1]

1856. Min., 2^h. Sherwill. Calcutta Sanitary Establishments, p. 74.

Months.	Min.	2h P.M.	Mean.	Months.	Min.	2h P.M.	Mean.
March	66	80	73	May	74	86	80
April	73	87	80	June	70	78	74

I add the following means from Nágpur in Berár, height 935 feet, for comparison:
March: 84·3 April: 93 May: 96·3 June: 86·0

[1] The highest points of the Table-Land reach 3,700 feet.

Jessór, in Bengál.

Latitude North.	Longitude East Green.	Height.
23° 9′·0	89° 7′·1♉	L.a.L.S.

1852-5. Palmer. 1852 and 1853: SR.; 9^h 50^m; 4; Noon; 2^h 40 ; 4; SS.—1854 and 1855: SR.; 10; 4; 10.

Schlagintweit, "Met. Mscr.," Vol. 18.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	....	.....	....	....	.....	58·1	69·5	63·8	62·0
February	61·8	79·5	70·65	67·2	77·6	72·4	65·5	75·8	70·65	71·2
March	71·3	82·2	76·75	73·0	86·9	79·95	73·2	85·2	79·2	78·6
April	77·5	90·8	84·15	79·7	89·5	84·6	....	....	.....	84·4
May	80·4	89·2	84·8	....	....	.....	....	....	.....	(84·8)
June	82·4	86·7	84·55	80·4	86·1	83·25	79·8	84·7	82·25	83·35
July	80·5	85·5	83·0	80·0	84·5	82·25	83·2	88·7	85·95	83·7
August	82·3	85·8	83·05	80·7	84·4	82·55	83·7	86·8	85·25	83·6
September	83·2	85·5	84·35	81·0	84·3	82·65	82·2	86·9	84·55	83·85
October	83·9	86·5	85·2	....	....	.....	....	....	.....	(85·2)
November	76·0	81·5	78·75	68·0	78·5	73·25	69·5	77·1	73·3	75·1
December	....	....	.....	....	....	.....	60·5	69·2	64·85	(64·85)
Year			.....			.....			.....	78·4

Isolated month (mean). 1855: Jan. 60·3, also included in the general mean.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·0	82·6	83·5	81·4	78·4

KACHÁR, or SÍLCHAR, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 48′·7	92° 43′·9 ♁	L. a. L. S.

1851-4. ROLFE. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 17.

Months.	1851 SR.	1851 4h P.M.	1851 Mean of the month.	1852 SR.	1852 4h P.M.	1852 Mean of the month.	1853 SR.	1853 4h P.M.	1853 Mean of the month.	1854 SR.	1854 4h P.M.	1854 Mean of the month.	General mean.
January	52·0	72·0	62·0	54·2	72·4	63·3	52·7	69·4	61·0	56·4	74·6	65·5	62·95
February	53·0	80·0	66·5	58·4	79·9	69·1	54·5	76·3	65·4	57·3	73·9	65·6	66·65
March	65·2	83·1	74·1	64·8	78·3	71·5	63·2	83·6	73·4	66·2	83·4	74·8	73·45
April	70·9	82·1	76·5	69·3	85·5	77·4	71·4	86·3	78·8	68·5	80·7	74·6	76·8
May	75·1	85·9	80·5	75·1	85·6	80·3	74·7	85·4	80·0	75·9	90·2	83·0	80·95
June	79·1	86·4	82·7	77·5	85·9	81·7	78·3	86·3	82·3	78·2	86·0	82·1	82·2
July	78·2	86·4	82·3	74·7	85·0	79·8	79·6	88·4	84·0	78·6	88·2	83·4	82·4
August	78·8	89·5	84·1	77·6	88·6	83·1	79·1	84·7	81·9	78·6	86·3	82·4	82·9
September	78·1	88·5	83·3	78·4	87·5	82·9	77·6	83·7	80·6	77·2	88·8	83·0	82·45
October	74·5	84·8	79·6	73·8	86·3	80·0	73·7	85·2	79·4	74·6	84·6	79·6	79·65
November	66·1	82·2	74·1	60·6	77·3	68·9	64·2	76·7	70·4	67·2	78·7	72·9	71·6
December	58·7	74·4	66·5	54·9	73·1	64·0	58·1	73·0	65·5	58·2	74·6	66·4	65·6
Year	for 1851: 76·0			for 1852: 75·2			for 1853: 75·2			for 1854: 76·1			75·6

General mean of the season and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·1	77·1	82·5	77·9	75·6

Kishánpur or Doránda, in Bengál.

Latitude North.	Longitude East Green.	Height.
23° 28′	85° 20′	Ab. 200 feet.

1852 and 1853. Brougham. Approximate means, deduced from extremes.

Schlagintweit, "Met. Mscr.," Vol. 11.

Months.	1852.	1853.	General mean.	Months.	1852.	1853.	General mean.
	Mean of the month.				Mean of the month.		
January	60·7	59·6	60·15	July	77·8	78·5	78·15
February	73·0	71·3	72·15	August	77·6	80·3	78·95
March	75·1	82·5	78·8	September	79·9	77·5	78·7
April	84·5	87·0	85·75	October	79·5	74·2	76·85
May	86·5	90·8	88·65	November	70·3	70·4	70·35
June	80·6	85·8	83·2	December	62·6	63·4	63·0
				Year	75·7	76·8	76·2

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·1	84·4	80·1	75·3	76·2

Maimăngsíngh, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 44′·8	90° 20′·9 ♉	L.a.L.S.

1851. Journ. As. Soc., 1852; for Febr. I also had the Manuscript details.

1852-4. Elton. SR.; 10; 4; SS. and SR.; 10; 12; 2^h 40, 4; SS. and Min.

Schlagintweit, "Met. Mscr.," Vol. 18.

Months.	1851	1852			1853			1554			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	62·0	54·2	68·2	61·2	54·4	68·2	61·3	57·5	73·1	65·3	62·45
Febr.	64·7*	61·0	75·3	68·1	60·1	78·2	69·15	57·9	70·7	64·3	65·95
March	75·1	65·6	79·5	72·5	69·4	88·5	78·95	67·4	85·1	76·25	75·8
April	77·3	72·7	85·4	79·0	76·5	90·8	83·65	72·5	83·2	77·85	74·45
May	82·8	78·4	86·1	82·2	77·1	89·9	83·5	82·3	91·1	86·7	83·8
June	82·3	78·8	84·5	81·6	79·3	88·9	84·1	78·8	83·5	81·15	82·3
July	84·5	79·1	83·6	81·3	79·4	88·9	84·15	80·4	87·7	84·05	83·5
Aug.	....	80·5	85·9	83·2	79·1	86·5	82·8	79·8	85·5	82·65	82·9
Sept.	....	79·6	84·4	82·0	78·6	83·4	81·0	79·1	87·0	83·05	82·0
Oct.	81·7	77·2	85·1	81·15	74·6	87·0	80·8	79·1	84·1	81·6	81·3
Nov.	74·5	65·1	77·7	71·4	66·0	77·7	71·85	67·8	78·1	72·95	72·7
Dec.	67·3	57·5	72·6	65·05	56·9	72·4	64·65	57·3	73·1	65·2	65·55
Year	....	for 1852: 75·7			for 1853: 77·2			for 1854: 76·7			76·0

*Isolated month (mean). 1851: Febr. 63·5 (from our original details).

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·6	78·0	82·9	78·7	76·0

Mídnapur, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 24′·3	87° 17′·9 ♁	L. a. L. S.

1854. Isolated months, Partridge. SR.; 10; 4; 10. The means for the year 1851 of the As. Journ. were left out, being much too hot.

1854				1854			
Months.	SR.	4h P.M.	Mean.	Months.	SR.	4h P.M.	Mean.
February	68·8	73·2	71·0	July	78·1	82·7	80·4
March	75·4	80·1	77·7	August	77·7	78·5	78·1
June	79·4	83·9	81·6	September	76·5	80·8	78·2

Monghír, in Bengál.

Latitude North.	Longitude East Green.	Height.
25° 27′·4	86° 40′·2 ♁	200 feet

1851		1851		1851	
Months.	Mean of the month.	Months.	Mean of the month.	Months.	Mean of the month.
January	65½	May	92½	September . . .	85
February	68	June	90	October	80½
March	76½	July	86	November	70½
April	84½	August	86½	December	. . . .

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
. . . .	84·5	87·5	78·7	. . . .

MURSHEDABÁD, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 11′·8	88° 9′·9 ♉	L.a.L.S.

1851. Journ. As. Soc. for 1852.
1852. KEAN. Means from SR. and 4.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 11.

Months.	1851	1852	1853	1854	General mean.
	Mean of the month.				
January	63	62	..	66	64·0
February	65·5	70	72	..	69·2
March	79·2	78	84	..	80·4
April	83·0	85	90	..	86·0
May	88 0	86	..	..	87·0
June	85·5	86	88	..	86·5
July	82·7	85	86	..	84·6
August	88·0	86	86	..	86·7
September	88	85	..	..	86·5
October	83	82	..	..	82·5
November	75	74	..	73	74·0
December	68	69	..	67	68·0
Year	79·1	79·0	..	..	79·6

Isolated month (mean). 1855: Jan. 64.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·1	84·5	85·9	81·0	79·6

NOAKÓLLI, in Bengál.

Latitude North.	Longitude East Green.	Height.
22° 45′·5	90° 57′·8♉	L. a. L. S.

1853 and 1854. DAVIS. Approximate means, from SR. and 4^h, but not quite regularly observed.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 18.

1854. Mean of the month.			
January	65·6	July	83·2
February	70·1	August	81·6
March	78·8	September	82·3
April	80·4	October	80·7
May	84·9	November	75·0
June	82·3	December	67·8
		Year	77·7

Isolated months (means). 1853: Nov. 75·2; Dec. 67·3.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·7	81·4	82·4	79·4	77·5

PÁBNA, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 1′	89° 12′	L. a. L. S.

1851. Journ. As. Soc., 1852, the results seem to be the means of the extremes.
1851-4. WILLIAM ELLIS. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 18.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	70·3	54	70	62·0	56	69	62·5	58	74	66·0	65·2
February	74·0	62	81	71·5	63	83	73·0	....	....	....	72·8
March	80·7	68	81	74·5	71	92	81·5	....	....	....	78·9
April	84·2	74	90	82·0	78	93	85·5	....	....	....	83·9
May	87·5	77	89·7	83·3	81	93	87·0	78	89	83·5	85·3
June	84·0	..	....	....	81	88	84·5	80	85	82·5	83·7
July	82·8	..	....	....	83	90	86·5	82	91	86·5	85·3
August	85·2	81	87	84·0	80	85	82·5	82·5	86·5	84·5	84·1
September	85·4	81	87	84·0	79	85	82·0	83·1	87·7	85·4	84·2
October	81·6	77	85	81·0	..	..	....	73	79	76·0	79·5
November	73·0	62	78	70·0	..	..	....	69	76	72·5	71·8
December	66·0	58	73	65·5	58	72	65·0	62	73	67·5	66·0
Year	79·6										78·4

Isolated months (means). 1851: Jan. 68·2; Febr. 73; March 80, excluded from the mean, the manuscripts I obtained not being complete.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
68·0	82·7	84·4	78·5	78·4

Parisnáth Peak, in Bahár.

Latitude North.	Longitude East Green.	Height.
23° 57′·8	86° 6′·9♁	4,496 feet (highest point)

June 1860 to May 1861: SR.; 9; Noon; SS. Observations made in connection with the erection of a Sanitarium. The means taken there from all the four hours are naturally too warm; I recalculated the means from the approximate extremes and I have added, to complete the yearly period, an estimated value for September, from analogy with the curves of neighbouring stations. Records of the Gov. Beng., XXXVIII., "Papers relating to a Sanitarium upon Mount Parisnáth." They contain also many valuable ethnographical and historical details.

1860-61.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	51·5	57·6	54·5	July	71·0	75·0	73·0
February	52·0	60·0	56·0	August	67·9	71·1	69·5
March	62·1	74·5	68·3	September	(66)	(70)	(68·0)
April	72·8	85·5	79·1	October	64·0	69·0	66·5
May	72·7	78·6	75·6	November	60·0	64·0	62·0
June	71·0	74·0	72·5	December	52·9	57·9	55·4

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
55·3	74·3	71·6	65·5	66·7

PÅRNEA, in Bengál.

Latitude North.	Longitude East Green.	Height.
25° 48'·0	87° 29'·6 ♁	L. a. L. S.

1850. STEALE. Means from Extremes.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 14.

1851. Journal As. Soc., 1852. Means; but, from comparisons made by my Assistant, Lt. ADAMS, a correction of — 1° Fahr. had to be applied.

1850		1851						General means.	
Mean of the month.		Mean of the month.							
Sept.	82·3	Jan.	63½	May	83½	Sept.	85	Sept.	83·6
Oct.	80·7	Febr.	64½	June	84½	Oct.	79	Oct.	79·8
Nov.	71·7	March	70½	July	87½	Nov.	70½	Nov.	71·1
		April	87	Aug.	83½	Dec.	64		
						for 1851: 76·9			

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·0	80·3	85·2	78·2	76·9

PÁTNA and DÁINAPUR, in Bengál.

PÁTNA: Latitude North.	Longitude East Green.	Height.
25° 37′·2	85° 7′·5	170 feet

1850 to 1851 and isolated months 1852 to 1853. TAYLOR, in Dáinapur. SR.; 9^h 50^m; 12; 2^h 40^m; 4^h; SS.; Min.

1853 and 1854. KNOTT, in Pátna. Means deduced from SR. and 4.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 13.

Months.	1850 to 1851 SR.	1850 to 1851 4^h P.M.	1850 to 1851 Mean of the month.	1853 Mean of the month.	1854 Mean of the month.	1855 Mean of the month.	General mean.
January	53·0	66·3	59·6	58·9	63·9	....	60·8
February	57·2	66·5	61·8	69·3	67·2	....	66·1
March	64·4	82·7	73·5	78·1	76·8	....	76·1
April	72·6	92·8	82·7	85·3	83·6	....	83·9
May	80·2	99·6	89·9	89·4	88·0	87·8	88·8
June	81·3	91·2	86·2	88·1	87·8	87·3	87·3
July	81·1	90·5	85·8	81·2	86·5	84·7	84·5
August	82·7	88·4	85·5	84·5	84·2	84·7	84·7
September	80·5	85·6	83·0	84·3	84·5	....	83·9
October	78·1	83·2	80·6	78·3	82·3	....	80·4
November	65·2	74·0	69·6	71·6	73·2	....	71·1
December	53·1	68·1	60·6	64·1	(65·0)	....	62·2
Year	for 1850 to 51: 76·7			77·7	78·6	....	77·4

DÁINAPUR: Isolated months (means), not quite complete, remained excluded. 1852: Jan. 57·3; Febr. 67·4. 1853: Jan. 61·2; Febr. 69·1; March 80·0.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
63·0	82·9	85·5	78·5	77·5

Rámpur Bóleah, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 21′·8	88° 34′·3 ♉	56 feet

1851-5. Bedford. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 14.

Compare also Dr. Bedford's "Memoir on the Meteorology of Rámpur Bóleah," Journal As. Soc., 1852, p. 593.

Months.	1851			1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	63	68	65·5	55·5	71·4	63·4	....	....	....	68·5	69·5	69·0	64·8
February	69	75	72·0	62·9	80·3	71·6	61·1	77·2	69·1	63·3	72·5	67·9	69·7
March	77	87	82·0	67·8	80·0	73·9	70·1	80·2	75·1	73·5	81·9	77·7	77·2
April	81	89	85·0	75·3	84·6	79·9	78·5	86·8	82·6	....	....	....	82·5
May	87	93	90·0	79·3	83·9	81·6	....	....	....	....	....	....	85·8
June	83	88	85·5	81·8	85·0	83·4	....	....	....	79·3	84·2	81·7	83·5
July	83	87	85·0	80·4	84·0	82·2	81·7	85·2	83·4	82·7	86·2	84·4	83·8
August	84	88	86·0	81·2	85·5	83·3	80·9	84·7	82·8	82·1	84·9	83·5	83·7
September	85	89	87·0	79·5	84·9	82·2	80·9	84·4	82·6	81·5	85·6	83·5	83·8
October	77	84	80·5	77·7	85·7	81·7	....	....	....	....	....	....	81·1
November	62	77	69·5	66·0	78·0	72·0	....	....	....	70·5	75·5	73·0	71·5
December	..	..	....	....	....	....	....	....	....	63·1	70·5	66·8	(66·8)
Year			....			....			....			....	77·8

Isolated month (mean). 1855: Jan. 61·5.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·1	81·8	83·7	78·8	77·8

RÁNGPUR, in Bengál.

Latitude North.	Longitude East Green.	Height.
25° 42′·8	89° 11′·4	72 feet

1851. Journal As. Soc., 1852. Mean of extremes.
1852-5. WALTER. SR.; $9^h\ 50^m$; Noon; $2^h\ 40^m$; 4^h; SS.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 15.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	63·3	....	....	....	....	....	....	....	....	....	61·5
February	68·7	....	....	....	....	....	....	53·5	79·0	66·2	67·5
March	79·8	69·5	80·7	75·1	61·4	90·3	75·8	57·1	82·6	69·8	75·1
April	82·6	68·8	87·9	78·3	75·7	93·6	84·6	....	....	....	81·8
May	86·2	71·6	85·2	78·4	....	....	....	....	....	....	82·3
June	83·7	69·8	85·3	77·5	77·7	87·1	82·4	76·2	86·7	81·4	81·3
July	84·5	70·2	84·2	77·2	82·8	86·9	84·8	79·4	91·5	85·4	83·0
August	84·5	70·1	87·1	78·6	78·8	86·7	82·7	82·9	89·1	86·0	83·0
September	87·1	70·6	84·6	77·6	77·6	86·3	81·9	81·3	92·4	86·8	83·4
October	80·0	73·8	87·5	80·6	....	....	....	....	....	....	80·3
November	79·0	66·5	81·9	74·2	63·7	82·3	73·0	63·6	82·5	73·0	74·8
December	70·6	....	....	....	....	....	....	56·4	79·0	67·7	69·2
Year	79·2			....			....			....	76·8

Isolated month (mean). 1855: Jan. 59·7, included in the mean.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·1	79·7	82·4	79·5	76·8

Ranigánj, in Bengál.

Latitude North.	Longitude East Green.	Height.
23° 35′	87° 7′	319 feet

May 1857: Lt. Adams. Hourly observations for defining the daily period; compare Chap. IV.
June 1860 to May 1861: SR.; 10; 4; 10. From February 1861: SR.; 9; 3; 10, also Noon and SS. instead of 3 and 10. The station had been erected there for providing materials for comparison with the temperature on Parisnáth. I have recalculated the means, a correction being applied for the hour. Records of the Gov. Beng., XXXVIII.

1860-1861.							
Months.	SR.	3 (and 4).	Mean.	Months.	SR.	4h.	Mean.
January	58·3	75·6	66·9	July	80·5	88·6	84·5
February	57·7	85·6	71·6	August	76·4	86	81·2
March	69·6	93·5	81·5	September . . .	79·1	91	85·0
April	78·6	103·4	91·0	October	73·8	84	78·9
May	80·8	96·4	88·6	November	67·0	75	71·0
June	82·8	89·0	85·9	December	57·3	73	65·1

Isolated month (mean). 1857: May 89·4.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·9	87·0	83·9	78·3	79·2

Rhotasgárh, in Bahár.

Latitude North.	Longitude East Green.	Height.
24° 38′	83° 50′	1,489 feet.

1860. Chánder Páttak. SR.; 10; 4; 10. Calcutta Sanitary Establ., 1861, p. 100.

1860							
Month.	SR.	4h P.M.	Mean.	Month.	SR.	4h P.M.	Mean.
August	80·2	82·8	81·5	September . . .	83·8	86·1	84·9

Comparative observations at the Rhotasgárh Hill and at Déri (q.v.) had given a decrease of temperature with height of about 300 feet corresponding to 1° Fahr.; though in analogy with the decrease in general in those latitudes, the absolute difference is too small to be taken into consideration as in any way important enough for sanitary purposes.

SILHÉT, in Bengál.

Latitude North.	Longitude East Green.	Height.
24° 53′·0	91° 47′·1 ♁	L.a.L.S.

1851-5. ANDREWS, SILVER, NORVAL. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 17.

Months.	1851			1852			1853			1854			1855			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	63·6	71·4	67·5	59·2	68·9	64·0	59·8	66·4	63·1	63·4	73·5	68·4	59·3	69·4	64·3	65·5
February	65·9	72·2	69·0	65·1	78·6	71·8	65·3	76·0	70·6	64·8	74·0	69·4	64·3	73·3	68·8	69·9
March	71·8	80·1	75·9	63·7	75·2	69·4	72·9	84·3	78·6	71·6	81·3	76·4	70·2	78·8	74·5	75·0
April	74·3	79·9	77·1	71·1	83·9	77·5	77·1	83·6	80·3	72·6	78·5	75·5	73·9	79·2	76·5	77·4
May	78·4	82·6	80·5	77·0	88·1	82·5	77·3	84·1	80·7	78·8	84·5	81·6	78·4	81·8	80·1	81·1
June	75·8	82·9	79·3	79·9	82·5	81·2	79·4	83·4	81·4	78·7	81·7	80·2	79·4	82·0	80·7	80·6
July	80·1	84·4	82·2	78·7	79·8	79·2	80·6	85·8	83·2	80·6	84·5	82·5	82·1	85·5	83·8	82·2
August	80·8	83·6	82·2	81·3	84·6	82·9	79·2	81·6	80·4	80·4	83·1	81·7	80·3	83·2	81·7	81·8
September	81·2	84·2	82·7	81·3	83·0	82·1	78·3	81·3	79·8	81·6	85·0	83·3	....	....	....	82·0
October	77·8	82·3	80·0	75·0	78·8	76·9	77·9	82·7	80·3	78·0	80·9	79·4	....	....	....	79·1
November	67·8	79·1	73·4	62·9	70·6	66·7	66·9	73·1	70·0	69·5	78·1	73·8	....	....	....	71·0
December	63·2	73·1	68·1	64·7	71·3	68·0	65·0	71·9	68·4	65·3	74·2	69·7	....	....	....	68·5
Year	for 1851: 76·5			for 1852: 75·2			for 1853: 76·4			for 1854: 76·8					....	76·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·6	77·8	81·5	77·4	76·2

TÍPPERA, in Bengál.

Latitude North.	Longitude East Green.	Height.
23° 27′·5	91° 2′·3 ♁	L.a.L.S.

1851. Journal As. Soc., 1852.
1852-4. WILLIAMS; SKINNER; DUKE. SR.; 10; 4; SS.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 19.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	69·2	57·3	65·9	61·6	55·4	70·7	63·05	58·4	71·9	65·1	64·7
February	71·4	61·8	74·0	67·9	60·0	76·3	68·1	60·7	71·8	66·2	68·4
March	77·0	66·0	76·3	71·1	70·3	85·4	77·8	74·1	78·9	76·5	75·6
April	82·1	73·3	88·3	80·8	78·0	87·1	82·5	75·8	82·4	79·1	81·1
May	83·3	71·8	84·4	78·1	79·9	86·5	83·2	78·8	88·0	83·4	82·0
June	80·6	78·9	83·3	81·1	79·7	86·1	82·9	78·5	84·4	81·4	81·5
July	81·5	77·9	80·3	79·1	80·3	85·6	82·9	79·9	85·7	82·8	81·6
August	82·2	79·7	84·0	81·8	79·1	85·1	82·1	78·1	84·3	81·2	81·8
September	81·2	79·5	83·1	81·3	78·5	82·8	80·6	78·9	85·7	82·3	81·3
October	78·4	77·4	81·7	79·5	76·8	87·2	82·0	75·9	85·7	80·8	80·2
November	72·7	67·5	74·3	70·9	67·0	78·1	72·5	68·1	77·7	72·9	72·2
December	66·1	59·6	72·1	65·8	60·1	70·6	65·3	(60·0)	(72·0)	66·0	65·8
Year	77·1	for 1852: 74·9			for 1853: 76·9			for 1854: 74·8			76·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·3	79·6	81·6	77·9	76·3

TIRHÚT, or MOZAFFERPÚR, in Bengál.

Latitude North.	Longitude East Green.	Height.
26° 7′·3	85° 22′·85	255 feet.

1833-6. DASHWOOD, Journal As. Soc., III., p. 80. Daily extremes.
1851. Journal As. Soc., 1852.[1]
1850, and 1852-4. KINSEY; SIMPSON. Means, probably $\frac{\text{SR. and 4}}{2}$.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 14.

Months.	1833	1834	1835	1836	1850	1851	1852	1853	1854	General mean.
	Means of the month.									
January	60·4	58·5	55·0	53·2	....	60·8	58·8	55·6	63·2	58·2
February	66·7	68·9	62·5	60·2	....	64·2	67·5	65·4	63·4	64·9
March	76·1	74·5	70·3	73·3	....	74·7	72·1	74·6	74·3	73·7
April	85·2	80·3	80·2	80·6	83·6	83·2	81·3	83·3	82·9	82·3
May	85·3	91·9	84·7	85·6	88·3	90·9	83·7	88·4	85·7	87·2
June	89·2	86·1	84·0	....	89·3	87·1	87·4	87·9	83·2	86·8
July	86·7	85·0	81·3	....	87·6	84·8	82·3	86·7	81·4	80·7
August	84·5	84·1	80·6	....	86·2	85·3	84·7	84·4	82·8	80·3
September	85·0	83·6	79·0	....	84·6	83·5	85·5	....	87·0	84·0
October	81·5	79·6	73·4	....	81·6	79·0	78·5	79·5	80·3	79·2
November	73·8	65·7	63·0	....	72·4	68·0	68·8	71·9	71·1	69·6
December	61·6	62·1	57·4	....	62·4	61·2	59·1	63·5	....	61·0
Year	78·0	76·7	72·6	....	....	76·9	75·8	....	....	75·7

Isolated month (mean). 1855: Jan. 59·9, not included in the mean, incomplete.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
61·4	81·1	82·6	77·6	75·7

[1] In PETERMANN'S Mittheilungen, 1864, No. X, p. 388, I find quoted a Report presented by Dr. THEODOR DUKA, from Monghír, to the Hungarian Academy: "Die geographischen und climatischen Verhältnisse des Ganges Delta" (On the Geology and Climate of the Delta of the Ganges). I had not had an opportunity of obtaining it before.

GROUP III: HINDOSTÁN,

THE UPPER GANGETIC PLAIN.

Ágra.	Gházipur.	Mírzapur.
Aligárh.	Gorákhpur.	Mozăfarpúr.
Allahabád.	Javánpur.	Muradabád.
Azimgárh.	Kálsi.	Panipát.
Baréli.	Kánhpur	Sahárаnpur.
Benáres.	Láknáu.	Sărauli.
Bijnúr.	Mainpúri.	Shahjehánpur.
Déhli.	Máthra.	Sítapur.
Étava.	Míráth.	Sultánpur.
Fătigárh.		

Hindostán, the broad depression between Băndelkhánd and the Himálaya, as far up as Aligárh only 750 feet in height, allows one particularly well to study Indian climate for territories in the interior at some distance from the seas on either side, when elevation does not interfere with the effects produced by the geographical position.

In its description I am assisted (besides the aid afforded by the numerous meteorological registers) by our routes from the countries north of the Himálaya to the southern parts of India repeatedly leading through the provinces of Hindostán.[1]

During the *cool season*, beginning in November and continuing till nearly the end of February, the climate of these parts of India is very agreeable: for weeks it might be said not to differ materially from the climate of Algiers, Egypt, or even the Ionian Islands, were it not that the power of insolation, when leaving the protection of shade, sufficiently reminds one of a lower latitude.

[1] For details of the routes, including those of the assistants Lt. ADAMS and Mr. MONTEIRO, see Vol. I., pp. 11 to 43.

With the exception of a few days of rain preceded by cloudy weather, the air is dry. In 1855 the rain set in as early as December, which is the usual time for these hibernal showers and thunderstorms; sometimes they are deferred till January or even February;[1] when they are passed the sky is almost free from clouds in any form, and the morning fogs and vapours of Bengál and Assám are unknown along the shores of the Ganges and Jămna. The nights are cool; just before sunrise a light breeze springs up from the west, and sweeping over a well-bedewed surface, it makes the air rather chilly. The artificial formation of ice in vessels protected (by being put into little ditches) from too free a contact with the wind succeeds very well in January and February.[2] Also natural shallow pools of water in sheltered situations are covered occasionally with thin films of ice, and hoar frost is found deposited. In the morning and evening fires are generally required in the houses.

This is the most healthy season of the year. The diseases are of an inflammatory nature, and fevers are easily removed. Hepatic disease, however, with a strong tendency to abscess is common during this season.

The *hot season* begins in March and lasts till June, but the early morning occasionally remains pleasant and cool till the middle of May. In March rain and sensible depression of temperature may take place; so it was from the 12th of March 1855, and 10 to 12 days of very variable weather followed, unpleasant stormy mornings alternating with cloudy days, close and heavy, since a few hours' break in the clouds was sufficient to be strongly felt by the insolation it allowed.

Also in the latter part of April 1855 the rain began again in unusual quantity from Calcutta up to Lăknáu, and all the Indian papers then were ready to call it the "most extraordinary weather that we ever remember to have seen," though a more detailed inspection of the registers shows it to be rain, but not quite so unusual as it might appear at first by the contrast it presents.

In April, or even sometimes about the middle of March, the hot westerly winds, descending the valley, set in. They at first begin about noon, later they gradually spring up at more early hours and occasionally continue to blow all night; but most generally

[1] So it was in 1865, heat and dryness then was felt very heavily; from Benáres to Gorákhpur there was some fear of a famine.

[2] The ice is most rapidly collected, thrown into pits mixed with straw, which are only opened at the beginning of the hot season, and which sometimes, when carefully managed, last a considerable time.

they abate very regularly towards evening, at least on the *surface* of the earth, the beginning of a calm nearly coinciding with the setting of the sun. Very frequently they carry with them great quantities of dust, which often conceal the sun for hours as perfectly as the heaviest watery clouds would do, and if they allow the sun to penetrate them its light is modified in a very peculiar manner.[1]

Occasionally there are also days in this season when an easterly wind blows. Then the air is rapidly freed from dust, but it is charged with atmospheric moisture even increasing to hazy vapour. The heat as measured by the thermometer is lessened, but it is more oppressive, since the dampness interferes with the evaporation of the body; also the *tattis,* or wetted screens, are then of scarcely any use, on account of the great humidity in the atmosphere.

The more *frequent* the changes in the direction of the winds, the more dense I found the haze to become, which then every evening covered all the sky, deepening towards the horizon. The calm which intervenes between these changes sometimes occasions an almost insupportable sensation of stifling heat, but such interruptions of the hot winds are more frequent in the lower parts than when approaching the Pănjáb.

Also in these regions rotatory squalls, analogous to the typhoons of the Indian ocean, not unfrequently come down from the north-west; though their violence as well as their direction is the same as that of the north-westers which I described as taking place in the eastern provinces in the cool season, they differ essentially by the comparatively little amount of rain, and by the immense quantity of dust they carry with them. They are not limited to any particular hour of the day; the dust may be mingled with large drops of rain occasionally in considerable abundance; but very frequently too these storms, then called dry north-westers, are without any actual fall of rain, and only dust is whirled about, glittering occasionally like millions of little specks in a hazy sunlight. Even the strong forms of hot winds cause a change in the atmosphere for the better; Ágra thus had, May 11 1855, a squall accompanied by hot wind ending in a dust-storm attended by thunder, which was followed by a depression of temperature during the calm night beneficial enough for this season;

[1] The details about the hot winds will be found in Vol. V.; there the currents of the atmosphere are compared and examined, and the modification of the colour of the solar light will be treated in connection with analogous optical phenomena.

also by such dry north-westers without rain the moisture is always increased, the temperature reduced, and a most welcome interruption of the uniformity of the hot season is produced.

If now, again, we think of the countries where climate differs so little from that of India in the cool season, the heat of India will be the more surprising. In Cairo, where Dr. REYHER, in 1857, made very careful observations for me in May and a part of June, the mean temperature was 75·9° Fahr.: in Ágra the mean for June is 94·8° Fahr.

Though extremely relaxing, this season is not generally unhealthy; many who have suffered severely from rheumatism, remittent fever, and spleen, enjoy better health than during any other period of the year. Digestion is also generally little interfered with.

The setting-in of the *rainy season* with the south-west monsun takes place about the end of May, in the lower parts middle of May; this first period of the rains, called the *chóta bărsát*, or lesser rains, is, however, very irregular in occurrence and duration, and is limited to the lower parts of Hindostán; the regular rains begin middle of June; 1855 no rain had fallen at Déhli the 20 of June; the heat, so materially increased by the insolation of the ground, becomes the more intense the more the hot season is prolonged; in the parts approaching the Pănjáb it is not unusual to see the hot season continued till end of June, and a great portion of my stations of Hindostán have the mean of June warmer than May; but July is cooler throughout. The end of the regular rains coincides with the beginning of September, occasionally they last till October, even at times including all this month.

The beginning of the precipitation is violent, 8 to 9 inches falling within the first 48 hours, accompanied by a high wind; it produces a very refreshing change of the atmosphere, but the insolation, even when mitigated by a hazy state of the air, is still very powerful for many an hour of the days next following.

So very great and sudden is the alteration coinciding with the full setting-in of the rains, that all over India, now even high up in the north-west, the years are counted by *rainy seasons*, by *várshas* or *básas*;[1] in fact *básas* has become used for "year." And strange, too, it is to see, that it was not the same throughout in Arian literature.

[1] For details about Indian seasons, see p. 115.

Those parts of the Vedas which we must consider the older we find counting by *himas*, or winters: those, however, to which, from their contents, must be assigned a more recent date, count by *sharáds*, or autumns (properly meant for the time from August to November, now limited about to September and October); an alteration in terminology evidently coinciding with the progress of the Arian nation from higher latitude and greater elevation at first into zones more temperate, and then, farther on still, into tropical regions.

The rains, however, are frequently amongst the most unhealthy parts of the year; dysentery is frequent and typhoid intermittent or remittent fevers very common, particularly among those cultivators whose occupation exposes them to unhealthy alluvial exhalations. Convalescence is slow during this season.

In *autumn* the cessation of the rains is succeeded by an interval of warm weather, which gradually becomes temperate and cool as the sun recedes towards the south. If the rains break up early in September, the weather is hot and insalubrious; the exsiccation of watercourses and marshes then going on with great rapidity and with much disengagement of miasm. Even as late as end of October days cloudy and warm are frequent; the setting-in of the cool season with the beginning of November, in most of the years I had occasion to examine, was preceded by some smart showers of rain.

In order to show the *absolute extremes* as they occur nearly every year, I cannot do better than select Fătigárh, as well on account of its situation—which is about central for the regions here under consideration—as, particularly, on account of the observations of Dr. Peyle, these being amongst the very best I got communicated by the medical board.

The observations of insolation are those of Dr. Wilkie at Mírăth, in 1859, for the northern, and of Dr. Parden, in 1856-1859, at Gházipur, for the southern part of Hindostán.

Table of absolute extremes
from observations at Fătigărh.

Months.	Extremes. Min.	Extremes. Max.	Months.	Extremes. Min.	Extremes. Max.
January	39	85	July	75	102
February	44½	90½	August	75	94½
March	51	93	September	67	96½
April	61½	104½	October	57	96½
May	67½	108	November	46	90½
June	71½	110½	December	39	76

Mean insolation.

Months.	Gházipur.	Mírăth.	Months.	Gházipur.	Mírăth.
January	90·3	86·8	July	111·6	117·1
February	98·5	85·0	August	107·9	99·0
March	111·3	99·6	September	111·1	101·0
April	121·5	108·9	October	109·2	103·0
May	125·4	118·7	November	101·8	96·0
June	119·0	113·1	December	89·9	84·1

Views from these provinces have not yet been given among the plates of the Atlas thus far published.

ÁGRA.

Latitude North.	Longitude East Green.	Height.
27° 10′·2	78° 1′·75	657 feet.

1850-7. *a*. For 1850 and 1851 we could obtain only the monthly means, no copy of originals being kept when the details were sent by the medical board to the Asiatic Society.

b. From 1854-7 our principal series was that made, at our request, near the office of the Secretary to Government N.W. Provinces by Mr. O'Connor; this careful series was also of particular value for calculating our barometrical observations; for the temperatures I was enabled for these years, as also for 1852 and 1853, to take means of different other series of observations made in connection with the respective regimental hospitals and with the jail. The names of the principal other observers are: Carmichael, Lobock, Maltby, Oakley, Strover, &c.

The hours of observation were, as usually, SR.; 10; 4, SS.; and SR.; $9^h\ 50^m$; 12; $2^h\ 40^m$; 4^h; 10.

The details fill a volume: Schlagintweit, "Met. Mscr.," Vol. 23. Parts of the latter series, with fewer hours, are also published in the Journal of the Asiatic Society of Bengál for the respective years.

Months.	1850	1851	1852			1853			1854		
	Mean of the month.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.
January	....	57·5	43·4	67·7	55·5	50·0	62·3	56·1	47·1	68·0	57·5
February	....	68	55·8	79·2	67·5	55·8	74·6	65·2	53·9	72·7	63·3
March	....	79·6	64·1	81·4	72·7	64·5	80·9	72·7	62·8	89·0	75·9
April	85·5	88·4	74·6	94·1	84·3	73·9	89·0	81·4	75·0	100·4	87·7
May	95·5	95·1	....	....	....	81·5	102·6	92·0	82·5	105·1	93·8
June	95·5	96·1	85·7	98·6	92·1	89·2	103·5	96·3	86·1	99·5	92·8
July	92·5	86·3	82·2	92·0	87·1	77·6	86·5	82·0	82·2	93·3	87·7
August	86·0	85·4	79·4	87·4	83·4	79·5	95·0	87·2	80·1	88·7	84·4
September . . .	84·0	83·6	78·9	91·1	85·0	80·2	96·0	88·1	77·5	87·9	82·7
October	76·0	81·2	68·8	80·6	74·7	69·8	88·7	79·2	69·7	87·0	78·3
November	66·0	67·4	60·6	84·8	72·7	59·2	82·4	70·8	56·1	78·9	67·5
December	59·5	....			....	46·8	73·0	59·9	51·1	70·1	60·6
Year						for 1853: 77·6			for 1854: 77·7		

1855			1856			General mean.
SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
44·6	65·6	55·1	53·0	73·1	63·0	57·5
54·6	76·6	65·6	56·7	79·4	68·0	66·4
63·5	83·7	73·6	70·2	93·2	81·7	76·0
72·0	89·8	80·9	78·7	102·3	90·5	85·5
83·5	107·5	95·5	87·4	106·0	96·7	94·8
88·9	102·9	95·9	82·4	95·1	88·7	93·9
76·8	85·8	81·3	80·9	89·0	84·9	86·0
80·4	95·4	89·4	78·2	84·4	81·3	85·3
74·8	88·8	81·8	76·9	88·4	82·6	84·0
70·0	88·0	79·0	67·3	89·9	78·6	78·1
60·8	80·0	70·4	59·9	80·0	69·9	69·2
62·3	72·5	62·4	46·7	70·9	58·8	60·2
for 1855: 77·6			for 1856: 78·7			78·1

Isolated months (means). 1857: Jan. 57·9; Febr. 67·2.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
61·4	85·4	88·4	77·1	78·1

Aligárh.

Latitude North.	Longitude East Green.	Height.
27° 53′·8	78° 39′·0	750 feet.

1852-4. Christie, Clark, Wilson, Butler. SR.; 10; 4; SS. As observations have been sent in, independent of each other, which had been made in the civil station and in the lines of the 24th Regiment, I could take the mean of both. They differed but little.

1855-6. Charles and Mrs. Gubbins (now Bothoe). 6; 10; 4; 9. Particularly correct and careful. Also Mr. Stewart Clerk, I was told by Mr. Bothoe, 1863, has continued these observations and sent them on to me, but they have not yet reached me.

Months.	1852			1853			1854			1855			1856			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	....	....	....	49·5	59·7	54·6	48·2	69·2	58·7	....	....	....	53·7	71·4	62·5	58·6
February	....	....	....	55·0	67·7	61·3	56·6	74·0	65·3	....	....	....	55·7	70·9	63·3	63·3
March	....	....	....	64·7	79·5	72·1	62·2	83·6	72·9	....	....	....	67·8	92·3	80·0	75·0
April	....	....	....	76·5	91·5	84·0	73·7	94·5	84·6	69·2	92·3	80·7	75·5	97·5	86·5	83·9
May	....	....	....	80·5	95·7	88·1	80·2	101·5	90·8	85·7	102·9	94·3	84·8	100·2	92·5	91·4
June	84·5	98·0	91·2	87·8	102·5	95·1	86·7	102·0	94·3	86·3	99·3	92·8	83·1	93·6	88·3	93·6
July	82·0	89·5	85·7	83·8	100·7	92·2	81·1	93·2	87·1	81·0	86·7	83·8	....	....	....	87·2
August	79·5	88·5	84·0	83·5	96·5	90·0	78·7	87·5	83·1	80·8	95·2	88·0	....	....	....	86·3
September	79·0	88·0	83·5	81·8	93·8	87·8	77·6	89·0	83·3	78·1	88·3	83·2	....	....	....	84·4
October	71·0	84·5	77·7	70·5	87·5	79·0	....	....	....	68·0	89·5	78·7	....	....	....	78·4
November	62·5	77·0	69·7	62·0	85·5	68·7	56·1	75·6	65·8	57·4	80·4	68·9	....	....	....	68·3
December	....	....	....	53·5	69·7	61·6	52·1	66·5	59·3	50·4	71·8	61·1	....	....	....	60·6
Year			....	for 1853: 77·8					....			....			....	77·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
60·8	83·4	89·0	77·0	77·5

ALLAHABÁD.

Latitude North.	Longitude East Green.	Height.
25° 26′·0	81° 51′·95	316 feet.

1850-4. PEMBERTON, BRYDON, KING. SR.; 10; 4; SS.; then SR.; 9^h 50^m; 12; 2^h 40^m; 4^h; SS. April, May, and June, for which no copy of the observations were handed over to me, had to be taken from As. Soc. Journ., 1852.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 20.

Months.	1850			1851			1852 to 1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	.....	....	60·2	68·0	64·1	(1852) 59·4	69·2	64·3	64·2
February	....	.....	....	61·6	73·6	67·6	....	.....	....	(67·6)
March	....	.....	....	69·1	85·6	77·3	....	.....	....	(77·3)
April	....	.....	....	....	....	(92·6)	....	.....	....	(92·6)
May	93·0	101·7	97·3	....	....	(100·1)	(1854) 90·6	100·2	95·4	97·6
June	90·4	96·5	93·4	....	....	(91·0)	89·2	93·9	91·5	91·9
July	89·7	95·5	92·6	86·1	88·8	87·4	84·7	89·8	87·2	89·0
August	84·4	87·6	86·0	86·0	90·4	88·2	82·9	86·6	84·7	86·3
September	83·4	89·3	86·3	83·5	88·6	86·0	82·6	87·0	84·8	85·7
October	80·3	88·6	84·4	79·0	84·9	81·9	....	....	....	83·1
November	68·3	80·1	74·2	....	....	....	65·9	72·4	69·1	71·6
December	60·3	70·5	65·4	....	....	....	61·1	67·8	64·4	64·9
Year			....			....			....	81·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·6	89·2	89·1	80·1	81·0

AZIMGÁRH, in Audh.

Latitude North.	Longitude East Green.	Height.
26° 32′·0	83° 9′·95	Ab. 550 feet.

1851. Journ. As. Soc., 1852.

1851-5. SUTHERLAND; PAYNE; STEWART; Jail Hospital. 1851-3: SR.; 9^h 50^m; Noon; 2^h 40^m; 4^h; SS.; Min. — 1854-5: SR.; 10; 4; Min.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 21.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	64·3	60·6	65·8	63·2	56·8	62·5	59·6	48·1	67·6	57·8	60·0
February	66·9	70·0	77·7	73·8	64·7	74·2	79·4	53·9	70·6	62·2	70·6
March	76·1	73·8	80·3	77·0	74·4	88·7	81·5	....	....	....	78·2
April	81·9	82·3	90·3	86·3	84·8	95·4	90·1	75·3	93·4	84·3	85·6
May	84·8	84·4	90·7	87·5	90·2	102·7	96·4	79·1	95·8	87·4	88·5
June	88·4	88·8	93·3	91·0	91·0	97·5	94·2	81·3	91·4	86·3	90·0
July	85·3	82·1	84·4	83·2	83·4	88·3	85·8	....	....	....	84·8
August	86·4	83·6	87·4	85·5	83·8	88·2	86·0	81·1	86·0	83·5	85·3
September	83·8	....	....	....	81·3	89·8	85·5	79·1	87·7	83·4	84·2
October	81·3	79·3	86·5	82·9	69·6	83·0	76·3	....	....	....	80·2
November	71·3	67·7	76·8	72·2	58·5	77·9	68·2	59·5	73·7	66·6	69·6
December	64·3	59·6	67·1	63·3	48·7	68·7	58·7	52·2	69·0	60·6	61·7
Year	77·9			....	for 1853: 80·1					....	78·2

Isolated month (mean), included in the general mean. 1855: Jan. 55·3.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·1	84·1	86·7	78·0	78·2

Baréli.

Latitude North.	Longitude East Green.	Height.
28° 22′·2	79° 23′·2	693 feet.

1851. Journ. As. Soc., 1852.

1851-5. Hall; Hay; Payne. Corrected means only, the observations not having been made quite regularly at the same hours.

Schlagintweit, "Met. Mscr.," Vol. 22.

Months.	1851	1852	1853	1854	1855	General mean.
	Mean of the month.					
January	60½	62·2	55·7	59·7	56·2	58·9
February	63	71·2	63·1	....	....	65·8
March	76	72	68·3	70·2	....	71·6
April	82	67·6	77·9	83·8	....	77·8
May	....	90	83·5	86·9	....	86·8
June	92¾	....	89·1	89·9	87·0	89·7
July	85½	....	84·2	85·5	82·0	84·3
August	87½	88·0	85·2	84·5	87·2	86·5
September	80	....	84·7	77·6	81·8	81·0
October	77½	83·3	75·6	77·3	....	78·4
November	....	74·9	67·5	....	....	71·2
December	56¾	63·3	59·6	61·3	....	60·2
Year	....	....	74·5	....	....	76·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
61·6	78·7	86·8	76·9	76·0

Benáres.

Latitude North.	Longitude East Green.	Height.
25° 18′·4	82° 59′·8	347 feet.

1824-6. Prinsep, Philosophical Transactions, 1828, p. 251.
1851. Journ. As. Soc., 1852.
1852-5. Leckie. 1852-3: SR.; 9h 50m; 12; 2h 40m; 4h; SS.—1854-5: SR.; 10; 4; 10; Min. Schlagintweit, "Met. Mscr.," Vol. 20.

The Parl. San. Rep., Vol. II., p. 118, contains a very good description of climate, but the numbers given for the year 1858 I left out, as they contain decided contradictions, such as: June, mean dry bulb 101·26, and mean maximum 89·5; or, August, mean dry bulb 84·88, mean maximum 83·3, &c. Besides, the hours of observation and their combination are not detailed.

Months.	1824	1825	1826	1851	1852			1853			1854			1855			General mean.
	Monthly means.				SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	60·3	63·5	63·9	64·3	49·8	70·1	59·9	53·1	66·6	59·8	52·1	75·8	63·9	51·1	71·1	61·1	62·1
Febr.	67·7	69·6	70·1	67·8	58·6	83·8	71·2	60·2	80·6	70·4	57·7	77·9	67·8	....	....	....	69·2
March	81·4	75·1	80·8	74·5	65·3	85·9	75·6	69·5	93·3	81·4	79·3	94·9	87·1	....	....	....	79·4
April	88·9	89·9	89·9	87·3	75·7	99·3	87·5	79·6	99·9	89·7	....	....	....	....	....	....	88·9
May	97·4	94·8	90·9	96·3	82·2	99·9	91·0	95·9	106·0	100·9	82·4	105·7	94·0	84·5	109·1	96·8	95·3
June	89·6	92·5	88·8	92·7	84·7	97·5	91·1	87·4	101·6	94·5	84·0	92·1	88·0	....	....	....	91·0
July	85·9	86·4	84·9	86·5	80·4	85·9	83·1	81·5	84·0	82·7	....	....	....	81·5	88·8	85·1	84·9
Aug.	85·5	87·5	84·1	86·0	81·4	88·7	85·0	81·5	90·2	85·8	81·1	87·8	84·4	82·5	92·0	87·2	85·7
Sept.	85·9	84·5	85·7	84·5	....	....	....	81·8	92·2	87·0	80·1	87·6	83·8	80·3	86·0	83·1	84·9
Oct.	81·0	80·9	82·6	81·6	73·2	91·3	82·2	71·5	86·0	78·7	....	....	....	75·7	89·8	82·7	81·4
Nov.	72·9	71·3	....	73·1	62·0	83·8	72·9	62·0	83·4	72·7	61·9	80·2	71·0	51·1	83·4	67·2	71·6
Dec.	63·3	63·6	....	68·3	51·9	72·3	62·1	52·8	75·8	64·3	54·6	74·0	64·3	....	....	....	64·3
Year	80·0	80·0	....	80·2			....	for 1853:		80·6			....			....	79·9

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·2	87·9	87·2	79·3	79·9

Bijnúr.

Latitude North.	Longitude East Green.	Height.
29° 22′	78° 9′	530 feet.

1851. Journ. As. Soc., 1852.

1854-5. Knight. SR.; 9; 10; Noon; 3; 4; 10.

Schlagintweit, "Met. Mscr.," Vol. 26.

1855,	Jan.	53·0	1851,	April	81	1851,	July	86		1851	Oct.	79	76·8
„	Febr.	64	„	May	87½	„	Aug.	87½		1854	Oct.	74·7	
1851,	March	74½	„	June	92	1851	Sept.	87	86·4	1854,	Nov.	65·9	
						1854	Sept.	85·8		1854,	Dec.	57	

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
58·0	81·0	88·5	76·4	76·0

Déhli.

Latitude North.	Longitude East Green.	Height.
28° 38′·9	77° 13′·15	827 feet.

1827-9. Observations by Major Oliver in Spry, "Modern India," Vol. I., p. 350, &c. He gives in a general table the mean temperature of the day and of the night: for the latter, however, the values for May, June, July, and August 1827, and September 1828, had to be interpolated. The regular hours of observation were throughout from April 1827 to August 1828: SR.; $2\frac{1}{2}$; from September 1828 to March 1830: 10 and 4 and some isolated months at noon. Besides, SR. and 4 were also observed together with the other hours in June, July, and August. This circumstance allowed me to compare the mean deduced from these hours (which was for June 92·1, July 87·6, August 82·7) with the mean values given by Oliver; they agree quite well with the arithmetical mean of his "day and night." His observations, however, were not all made in Déhli itself, but at various places in its environs.

1851-4. The observations by Ross, Bond, and Balfour were made in the European station, situated on a slight undulation of the ground. The hours of observation were

1851: SR. and 2^h 40^m P.M.; but we ourselves got only four months. The mean of the twelve months of the As. Soc. Journ., vol. 1852, are decidedly much too warm in the hot season, when compared with respective months of the other years. I have left them out. 1852: SR.; 9^h 50^m; 2^h 40^m; 4. 1853: SR.; 10; 4; SS. 1854: SR.; 12; SS. For calculating the mean I deduced the temperature at 4 from the observations at noon, by applying a correction based on the *difference* of these two hours shown by the observations of 1852.

DÉHLI.

Months.	1827	1828	1829	1851			1852			1853			1854			General mean.
	Mean of the month.	Mean of the month.	Mean of the month.	SR.	$2^h\ 40^m$	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	54·0	52·0	55·9	47·0	62·8	54·9	42·3	64·1	53·2	49·5	62·0	55·7	48·9	70·4	59·6	55·0
February	62·3	54·3	58·9	51·0	71·1	61·0	54·2	71·5	62·8	58·5	75·0	66·7	51·1	67·2	59·1	60·7
March	70·0	67·2	69·5	58·1	83·1	70·6	61·6	72·6	67·1	....	....	....	60·2	82·1	71·1	69·2
April	79·5	76·7	82·2	....	....	....	67·4	83·3	75·3	....	....	....	72·5	93·0	82·7	79·3
May	(87·5)	84·6	92·8	....	....	....	74·8	87·7	81·2	79·5	95·5	87·5	79·3	97·6	88·4	87·0
June	(90·5)	92·0	91·0	84·1	99·0	91·5	82·1	96·8	89·4	89·5	94·0	91·7	86·9	96·6	91·7	91·1
July	(88·5)	86·8	80·1	....	....	....	81·0	89·5	85·2	....	....	....	78·5	92·3	85·4	85·2
August	(83·5)	82·2	80·9	....	....	....	78·4	83·1	80·7	....	....	....	82·5	88·3	85·4	82·5
September	81·2	(82·5)	79·6	....	....	....	76·2	87·1	81·6	....	....	....	78·2	88·0	83·1	81·6
October	73·9	73·9	74·9	....	....	....	....	....	....	....	....	....	65·8	84·1	74·9	74·7
November	63·0	60·2	63·7	....	....	....	....	....	....	....	....	...	54·7	75·5	65·1	63·0
December	55·1	58·5	54·7	....	....	....	....	....	....	....	....	....	50·3	66·5	58·4	56·7
Year	74·1	72·6	76·7			....			....			....	for 1854: 75·4			73·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
57·5	78·5	86·3	73·0	73·8

As a modification interesting for many an analogous case I add the *Mean within the city walls*, from observations extending over a period of 3 year. Parl. San. Rep., Vol. II., p. 112. The resulting temperature is about two degrees warmer than in the European station.

Mean of the months. (Years not indicated.)											
January	56	March	72	May	91	July	86	September	83	November	65
February	61	April	83	June	92	August	83	October	77	December	58
Year 75·6											

ÉTAVA.

Latitude North.	Longitude East Green.	Height.
26° 45′·5	78° 59′·9	550 feet.

1850-4. CUMBERLAND, LITTLER, GUISE, MACDONALD. SR.; 10; 4; SS. Also 1851 I got in original.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 20.

Months.	1851			1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	50·7	66·5	58·6	43·0	69·7	56·3	43·5	65·9	54·7	53·1	74·7	63·9	58·4
Febr.	53·5	71·5	62·5	53·0	80·7	66·8	50·5	80·3	65·4	55·8	73·7	64·7	64·8
March	62·2	83·2	72·7	63·2	83·0	73·1	59·5	90·7	75·1	64·8	88·8	76·8	74·4
April	72·0	93·0	82·5	70·0	98·0	84·0	68·7	92·8	80·7	....	....	....	82·4
May	80·7	101·0	90·8	78·5	101·0	89·7	77·3	102·8	90·0	79·0	99·6	89·3	89·9
June	86·7	102·2	94·4	82·0	98·7	90·3	84·7	103·5	94·1	85·0	97·5	91·2	92·5
July	80·5	89·5	85·0	81·0	91·2	86·1	79·7	89·3	84·5	80·0	79·7	79·8	85·3
Aug.	80·5	89·7	85·1	79·2	88·7	83·9	80·4	93·5	86·9	77·7	86·0	81·8	84·4
Sept.	75·2	91·0	83·1	78·2	91·5	84·8	78·5	94·0	86·2	76·6*	87·1	81·8	84·0
Oct.	65·0	91·0	78·0	65·0	95·5	80·2	65·5	89·2	77·3	....	....	....	77·8
Nov.	51·2	78·7	64·9	51·0	83·5	67·2	....	....	....	60·7	74·2	67·4	66·5
Dec.	43·2	72·7	57·9	43·2	68·7	55·9	....	....	....	49·7	68·5	59·1	57·6
Year	for 1851: 76·3			for 1852: 76·5					....			....	76·5

Isolated months (means). 1850: July 91·2; Aug. 84·1; Sept. 83·8; Oct. 75·7.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
60·3	82·2	87·4	76·1	76·5

FĂTIGÁRH, OR FARRUKABÁD.

Latitude North.	Longitude East Green.	Height.
27° 23′·3	79° 37′·05	635 feet.

1851. Journ. As. Soc., 1852; but the months given in detail could be taken from the original registers.
1851-3. PYLE. SR.; 10; 4; SS.; 10; Min.
1854 and 1855. MALTBY. SR.; 10; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 22.

The observations of Dr. PYLE can be mentioned as particularly detailed. Besides the temperature, a great variety of other meteorological phenomena were observed, the results of which will be found mentioned in the respective chapters.

Months.	1850			1851			1852			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	46·9	63·6	55·25	....	....	59·7	45·7	73·0	59·35	51·1	72·4	61·25	57·9
Febr.	52·1	72·6	62·35	....	....	64·7	53·6	81·6	67·6	60·2	75·1	67·65	65·8
March	59·6	86·5	73·05	....	....	75·5	59·3	81·4	70·35	65·5	89·7	77·6	74·1
April	68·0	94·2	81·1	....	....	85·0	68·1	94·4	81·25	....	....	.....	82·4
May	76·5	102·8	89·65	....	....	92·6	76·5	97·3	86·9	83·3	107·8	95·55	91·2
June	82·9	98·6	90·75	....	....	92·2	81·0	93·0	87·0	87·4	98·1	92·75	90·7
July	85·5	94·9	90·2	78·9	87·3	83·1	79·8	87·3	83·55	82·6	93·6	88·1	86·2
Aug.	79·3	87·0	83·15	79·0	88·2	83·6	79·2	87·3	83·25	81·8	88·0	84·9	83·7
Sept.	78·2	90·0	84·1	74·6	89·3	81·95	77·5	88·9	83·2	80·1	88·7	84·4	83·4
Oct.	68·0	84·7	76·35	65·5	89·0	77·25	65·4	88·7	77·05	....	....	.....	76·9
Nov.	55·0	79·6	67·3	....	....	69·4	55·7	80·1	67·9	60·2	76·5	68·35	67·8
Dec.	47·1	71·9	59·5	....	....	63·4	45·0	69·4	57·2	51·4	69·5	60·45	59·0
Year	for 1850: 76·06			for 1851: 78·95			for 1852: 75·4					.....	76·6

Isolated months (means); included. 1853: Jan. 55·1; Febr. 66·7. 1855: Jan. 56·9.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
60·9	82·6	86·9	76·0	76·6

Gházipur.

Latitude North.	Longitude East Green.	Height.
25° 33′·6	83° 31′·8 ♉	351 feet.

1851. Journ. As. Soc., 1852.
1854. Parden; native doctor; Lyell. Only approximated means.
Schlagintweit, "Met. Mscr.," Vol. 21.
1856-9. Parl. San. Rep., Vol. II., p. 217.

Being more detailed I preferred receiving the latter series alone into my general table.

A. Mean of the months, 1851 and 1854.

Months.	1851	1854	Months.	1851	1854.
January	64½	63·6	July	88	....
February	68	67·0	August	86	84·9
March	79	....	September	86	86·1
April	88	86·0	October	83½	....
May	95	92·5	November	69	72·3
June	91½	88·7	December	64	65·9

Mean of 1851: 80·2

B. Mean of the months, 1856 to 1859.

Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	56·5	78·5	67·5	July	82·75	96·75	89·75
February	60	83·75	71·8	August	81·25	100·25	90·75
March	66·75	95	80·9	September	80·5	93	86·7
April	77·25	99	88·1	October	73·75	91	82·37
May	82	105	93·5	November	62·25	85·25	73·75
June	82·25	102·75	92·5	December	56	73·5	64·75

General mean of the seasons and of the year (1856 to 1859).

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
68·0	87·5	91·0	80·9	81·9

GORÁKHPUR.

Latitude North.	Longitude East Green.	Height.
26° 46′·1	83° 18′·75	340 feet.

1851. Journ. As. Soc., 1852.

1850-4. PAYNE; PEMBERTON; ATCHISON. 1850-3: SR.; 9^h 50^m; 12; 2^h 40^m; 4^h; SS. 1854: SR.; 10; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 21.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	62·2	57·5	62·1	69·8	56·7	61·0	58·8	57·5	(62·0)	59·7	62·6
February	65·4	65·1	71·2	68·1	64·6	70·2	67·4	60·9	71·7	66·3	66·8
March	75·0	69·3	76·2	72·7	74·2	77·6	75·9	....	....	....	74·5
April	82·9	78·6	83·8	81·2	81·1	86·7	83·9	77·7	91·6	84·6	83·1
May	90·8	82·9	86·8	84·8	85·7	94·3	90·0	83·0	92·6	87·8	88·3
June	89·2	84·0	89·7	86·8	86·1	89·8	87·9	83·9	91·0	87·4	87·8
July	85·9	81·6	83·9	82·7	83·3	86·5	84·9	....	....	....	84·5
August	86·2	83·0	85·8	84·4	80·1	86·0	83·0	83·1	85·8	84·4	84·5
September	84·7	....	....	....	82·6	85·4	84·0	81·8	85·8	83·8	84·2
October	80·8	72·5	80·3	76·4	75·1	80·2	77·6	....	....	....	78·3
November	70·4	67·3	68·9	68·1	65·6	75·5	70·5	66·4	76·8	71·6	70·1
December	63·2	60·5	64·7	62·6	56·9	70·0	63·4	58·8	70·7	64·7	63·4
Year	78·1			....		for 1853: 77·3				....	77·3

Isolated month (mean). 1850: Dec. 63·2.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·3	82·0	85·6	77·5	77·3

JAVÁNPUR.

Latitude North.	Longitude East Green.	Height.
25° 43′·8	82° 40′·7♁	Ab. 380 feet.

1851. Journ. As. Soc., 1852, incomplete.
1854-5. COCKBUN. SR.; 10; 4; 10. SCHLAGINTWEIT, "Met. Mscr.," Vol. 21.

Months.	1851 Mean of the month.	1854 SR.	1854 4h P.M.	1854 Mean of the month.	General mean.	Months.	1851 Mean of the month.	1854 SR.	1854 4h P.M.	1854 Mean of the month.	General mean.
January	58½	48·1	68·8	58·4	57·5	July	....	....	....	....	....
February	65	53·4	70·5	61·9	63·4	August	....	80·4	84·7	82·5	(82·5)
March	74	....	....	....	(74·0)	September	....	80·3	86·2	83·2	(83·2)
April	82½	73·6	90·8	82·2	82·3	October	80	....	....	....	(80·0)
May	....	78·2	94·2	86·2	(86·2)	November	68	60·7	73·0	66·8	67·4
June	....	82·2	92·2	87·2	(87·2)	December	57½	54·8	67·4	61·1	59·3

Isolated month (mean). 1855: Jan. 55·7.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
60·1	80·8	....	76·9	....

KÁLSI.

Latitude North.	Longitude East Green.	Height.
30°	77½	Ab. 1,100 feet.

1837 (May) to 1838 (Dec.). PIGOT. Calcutta Journal Nat. Hist., IV., p. 414; approximated means.

Means of the month.

January	58·3	April	77·7	July	83·7	October	70·8
February	61·0	May	81·2	August	80·2	November	63·2
March	62·6	June	86·0	September	77·2	December	59·7

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
59·6	73·8	83·3	70·3	71·8

KÁNHPUR.

Latitude North.	Longitude East Green.	Height.
26° 28′·3	80° 20′·3♁	525 feet.

1834-5. POLLOCK. Journ. As. Soc., V., p. 823, is left out, since only the means of 10 and 4 are given, which are naturally too hot throughout the year.

1850-6. From 5 different regiments. I took the mean. The hours of observation were: 1850-4, SR.; 10; 4; SS.—1855 and 1856, SR.; 12; SS.

Months.	1850			1851			1852			1853			1854			1855			1856			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	Noon.	Mean of the month.	SR.	Noon.	Mean of the month.	
Jan.	....	....	....	53·6	68·1	60·8	....	....	....	49·4	63·0	56·2	53·6	60·2	56·9	49·5	56·6	53·0	62·7	66·2	64·4	58·3
Febr.	....	....	....	56·8	73·8	65·3	63·0	77·2	70·1	55·9	71·1	63·5	57·3	74·3	65·8	64·8	68·1	66·4	65·2	69·5	67·3	66·4
March	....	....	....	65·7	82·1	73·4	68·7	79·1	73·9	67·0	85·8	76·4	70·6	84·4	77·5	70·6	74·9	72·2	78·3	83·4	80·8	75·7
April	....	....	....	....	....	88·9	80·9	96·8	88·8	77·1	93·3	85·2	....	....	....	80·2	86·1	83·1	84·4	91·9	88·1	86·3
May	....	....	....	....	....	95·3	86·6	102·7	94·6	85·3	104·9	95·2	81·4	97·2	89·3	93·6	98·5	96·0	....	....	....	93·8
June	....	....	....	....	....	95·8	86·8	97·4	92·1	86·8	101·2	94·0	87·3	93·7	90·5	95·1	98·2	96·6	....	....	....	93·4
July	....	....	....	82·8	86·7	84·7	81·0	86·5	83·7	81·7	88·8	85·2	84·7	88·7	86·7	84·9	86·1	85·5	....	....	....	85·2
Aug.	82·3	83·7	83·0	82·6	87·9	85·2	83·5	87·0	85·2	81·1	90·9	86·0	82·3	92·5	87·4	87·7	89·7	88·7	....	....	....	85·9
Sept.	83·0	84·1	83·5	78·4	88·1	83·2	83·0	84·5	83·7	79·8	92·7	86·2	80·7	90·2	85·4	85·7	87·8	86·7	....	....	....	84·8
Oct.	76·7	78·5	77·6	....	....	77·5	....	....	....	....	....	....	....	....	....	78·1	80·2	79·1	....	....	....	78·1
Nov.	67·3	69·0	68·1	....	....	72·0	....	....	....	....	....	....	61·3	74·1	67·7	69·7	73·6	71·6	....	....	....	69·8
Dec.	58·2	59·7	58·9	....	....	....	50·9	68·3	59·6	....	....	....	55·6	74·3	64·9	61·6	65·5	63·5	....	....	....	61·7
Year			....			....			....			....			....	for 1855: 78·5					....	78·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·1	85·3	88·2	77·6	78·3

Lăknáu, the capital of Audh.

Latitude North.	Longitude East Green.	Height.
26° 51′·2	80° 55′·45	535 feet.

April 1858 to March 1860. Campbell (Engineer), Oakley (Surgeon). Mean of the extremes. Parl. San. Rep., Vol. II., p. 105.

When I was in Lăknáu, April 1856, I had left instruments put up in the Residency compound, but the observations were soon discontinued.

Months.	1858			1859			1860			General mean.
	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	
January	..	...	....	51	76	63·5	54	79	66·5	65
February	..	...	....	57	76	66·5	60	79	69·5	68
March	..	...	....	62	86	74	75	92	83·5	79
April	83	99	91	73	96	84·5	..	..	....	88
May	82	88	90	80	102	91	..	..	....	90·5
June	82	100	91	82½	95½	89	..	..	....	90
July	80	95	87·5	79	96	87·5	..	..	....	87·5
August	79	89	84	83	86	84·5	..	..	....	84
September	81	84	82·5	83	91	87	..	..	....	85
October	66	84	75	79	87	83	..	..	....	79
November	62	76	69	62	80	71	..	..	....	70
December	57	67	62	52	65	58·5	..	..	....	60
			....	Mean of 1859: 79					....	

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·3	71·6	89	78	76

MAINPÚRI.

Latitude North.	Longitude East Green.	Height.
27° 14′	79° 2′	620 feet.

1851. Journ. As. Soc., 1852; but the temperatures are so irregular, that I excluded them.
1854. In the hospital verandah. Means, probably based on extremes.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 24.

1854, Means.							
January	58	April	93	July	88	October	73
February	68	May	94	August	83	November	68
March	73	June	91	September	80	December	60

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·0	86·7	87·3	73·7	77·4

MÅTHRA.

Latitude North.	Longitude East Green.	Height.
27° 30′·2	77° 40′·3	655 feet.

1852 and 1853. Horse Artillery lines, CAMPELL, GRINSON; two series: SR.; 10; 4; SS. I took the mean.
1854. Light Calvary lines, WILSON. SR.; 10; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 24.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	....	....	53·0	61·5	57·2	58·0	69·5	63·7	60·4
February	....	....	....	62·7	76·0	69·3	61·5	70·0	65·7	67·5
March	70·0	73·5	71·7	70·7	84·2	77·4	69·0	79·5	74·2	74·4
April	78·0	85·2	81·6	79·2	89·5	84·3	80·5	92·5	86·5	84·1
May	84·2	89·2	86·7	86·0	95·7	90·8	85·5	96·7	91·1	89·5
June	88·7	93·0	90·8	91·0	99·7	95·3	91·0	97·0	94·0	93·4
July	84·2	88·0	86·1	84·2	88·2	86·2	85·5	91·0	88·2	86·8
August	82·7	85·0	83·8	86·0	95·7	90·8	82·5	87·5	85·0	86·5
September	82·0	85·7	83·8	84·2	94·2	89·2	82·2	87·7	84·9	86·0
October	76·5	82·7	79·6	76·0	85·2	80·6	....	....	....	80·1
November	69·2	74·2	71·7	68·5	78·5	73·5	65·7	75·7	70·7	72·0
December	....	....	....	59·2	71·0	65·1	49·7	71·2	60·4	62·7
Year			....	for 1853: 80·0					....	78·6

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
63·5	82·7	88·9	79·4	78·6

Mírăth.

Latitude North.	Longitude East Green.	Height.
29° 0′·7	77° 41′·6♉	859 feet.

1850-6. These extensive series I owe chiefly to the kind exertions of Dr. Rae, the superintending surgeon; 1850 and 1851 remained, however, incomplete, no complete copy of the details having been retained. I name as observers mentioned in the manuscripts: Bruce, Elderton, Hare, Jackson, &c. For 1852, 1854, and 1855 I received two series, of which I took the mean. The hours of observations were partly SR.; 10; 4; 10; partly SR.; $9^h\ 50^m$; 12; $2^h\ 40^m$; SS.

Schlagintweit, "Met. Mscr.," Vol. 25.

For April to October 1850, Mr. Charles Gubbins C.S. has published a very detailed diagram showing the daily register of the temperature; Journ. As. Soc. Bengal, Vol., 1852, plate preceding, p. 563. The numbers upon which they are based are not given there.

Months.	1851 and 50			1852			1853			1854			1855			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
	1851															
Jan.	53·4	60·8	57·1	51·2	63·8	57·5	51·2	60·5	55·8	55·8	66·0	60·9	40·5	61·1	50·8	56·9
Febr.	57·6	66·9	62·2	62·3	70·7	66·5	59·3	69·8	64·5	54·0	67·8	60·9	48·7	72·5	60·6	62·9
March	65·5	80	72·7	65·0	73·9	69·4	67·1	80·1	73·6	60·4	82·7	71·5	55·9	76·4	66·1	70·7
	1850															
April	73·8	86·7	80·2	74·6	86·5	80·5	75·8	84·0	79·9	75·8	96·3	86·0	65·8	85·8	75·8	80·5
May	85·0	96·7	90·8	81·3	90·8	86·0	82·3	92·4	87·3	81·0	96·3	88·6	78·4	103·7	91·0	88·7
June	88·6	96·9	92·7	84·9	93·1	89·0	88·1	96·0	92·0	87·0	98·5	92·7	83·1	102·7	92·9	91·9
July	87·7	93·7	90·7	82·5	88·2	85·3	82·2	85·9	84·0	82·3	91·2	86·7	77·5	86·4	81·9	85·7
Aug.	82·6	87·0	84·8	81·2	85·4	83·3	84·2	92·0	88·1	80·3	88·1	84·2	78·4	94·3	86·3	85·3
Sept.	81·1	88·0	84·5	80·2	87·4	83·8	82·5	90·4	86·4	78·6	90·2	84·4	74·6	87·0	80·8	84·0
Oct.	72·5	82·0	77·2	71·9	85·1	78·5	71·7	86·1	78·9	64·3	82·3	73·3	62·6	87·5	75·0	76·6
Nov.	62·4	74·8	68·6	63·6	74·4	69·0	64·0	74·3	69·1	54·2	74·2	64·2	52·0	81·9	66·9	67·6
Dec.	58·1	65·3	61·7	52·5	62·8	57·6	55·1	63·4	59·2	46·6	65·1	55·8	44·3	74·3	59·3	58·7
Year	1851 and 50: 76·9			for 1852: 76·4			for 1853: 74·9			for 1854: 75·8			for 1855: 74·8			75·8

Isolated months (means). 1856: Jan. 59·5; Febr. 62·9.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
59·5	80·0	87·6	76·1	75·8

Mírzapur.

Latitude North.	Longitude East Green.	Height.
25° 9′·3	82° 33′·9 ǒ	362 feet.

1851. I take the respective isolated months from Journ. As. Soc.; but the warmer months seem to be too hot.

1854-5. Pemberton. Approximate means.

Schlagintweit, "Met. Mscr.," Vol. 20.

1851, Means.							
January	60	April	88?	July	....	October	$84\frac{1}{2}$?
February	$72\frac{1}{2}$	May	96?	August	....	November	71
March	....	June	96?	September	....	December	64

This series, being incomplete and decidedly too hot, is not included in the mean.

1854, Means.							
January	62	April	83	July	87	October	80
February	64	May	90	August	86	November	70
March	75	June	90	September	85	December	64

1855, Jan. 61.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
63	83	88	78	78

MOZĂFARPÚR.

Latitude North.	Longitude East Green.	Height.
26° 7′	83° 21′	(300 feet.)

Observations of 3½ years; SR. and Max., from DOVE's "Nichtperiodische Aenderungen der Temperaturvertheilung," IV., p. 101.

Means of the month.

January	56·8	July	84·4
February	64·6	August	83·0
March	73·6	September	82·6
April	77·1	October	78·1
May	86·9	November	67·5
June	86·4	December	60·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
60·8	80·7	84·6	76·1	75·6

MURADABÁD.

Latitude North. 28° 49′ — Longitude East Green. 78° 56′ — Height. 673 feet.

1853-5. W. S. STIVEN (? — name not well legible). ROB. ULLAN. SR.; 9; 10; 3; 4; 10.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 26.

1851, Means, Journal As. Soc., was excluded, being much too hot (probably from an improper combination of the hours, from May to October especially).

Months.	1851	1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	50·0	58·5	54·25	57·0	66·5	61·75	58·0
February	63½	57·0	70·5	63·75	54·0	62·0	58·0	60·9
March	72½	67·5	84·5	76·0	63·0	75·5	69·25	72·6
April	81½	71·5	85·5	78·5	76·5	89·0	82·75	80·6
May	92	81·5	91·5	86·5	82·0	92·0	87·0	86·75
June	93	86·5	92·0	89·25	86·0	90·5	88·25	88·75
July	86	81·5	86·0	83·75	82·5	86·5	84·5	84·1
August	87½	83·0	88·0	85·5	81·0	84·0	82·5	84·0
September	84	81·5	90·0	85·7	79·5	83·0	81·25	83·5
October	84	74·5	81·0	77·75	68·5	75·5	72·0	74·9
November	....	62·5	72·5	67·5	60·5	69·0	64·75	66·1
December	....	52·5	64·5	58·5	55·0	63·0	59·0	58·75
Year	....	for 1853: 75·5			for 1854: 74·2			74·8

Isolated month (mean). 1855: Jan. 55·5, incomplete.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
58·9	80·0	85·6	74·7	74·8

PANIPÁT.

Latitude North. 29° 23′ — Longitude East Green. 76° 59′ — Height. 936 feet.

1852. Observations in the Jail compound, by native Doctor, at 9½ A.M. SCHLAGINTWEIT, "Met. Mscr.," Vol. 26.

1852, Means of the month.					
January	56·1	April	80·4	July	88·6
February	74·4	May	86·0	August	86·3
		June	91·6		

Mean of the season June to Aug.: 88·8.

Saháranpur.

Latitude North.	Longitude East Green.	Height.
29° 57′·2	77° 28′·8 ♁	1002 feet.

1826-7. Journ. As. Soc., III., p. 21.
1851. Journ. As. Soc., 1852.
1850-5. Heathcote; Plaifair. SR.; 9^h 50^m; 2^h 40^m; 4^h; SS.; 10.
Schlagintweit, "Met. Mscr.," Vol. 26.

Forbes Royle, in his "Culture of Cotton," also gives a general average.

Months.	1826	1827	1851	1852			1853			1854			General mean.
	Means of the month.			SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	51·7	52	48	54·7	64·5	59·6	54	62	58·0	54·6	69·3	61·9	55·5
February	52·6	55	55½	59·4	71·3	65·3	58	72	65·0	55	65	60·0	58·9
March	73·6	67	61½	67·4	72·6	70·0	68	88	78·0	65	81	73·0	70·5
April	79·6	78	72½	73·3	86·6	80·0	74	89	81·5	74	93	83·5	78·5
May	85·1	85	84·3	79·5	92·5	86·0	83	99	91·0	84	102	93·0	88·3
June	91·0	90	94·8	84·6	94·2	89·4	87	97	92·0	86	101	93·5	91·8
July	86·3	85	86	85·5	91·5	88·5	85	90	87·5	85	93	89·0	87·0
August	83·5	83	90	81·5	86·5	84·0	87	96	91·5	84	90	87·0	86·5
September	83·0	79	82	80·5	89·5	85·0	82	92	87·0	80	86	83·0	83·1
October	72·7	74	78	72·5	89·5	81·0	73	85	79·0	72	87	79·5	77·4
November	62·7	64	68·4	61·5	75·5	68·5	62	76	69·0	60	78	69·0	67·0
December	59·7	55	62·6	54·5	68·5	61·5	55	71	63·0	55·5	68·9	62·2	60·7
Year	73·5	72·2	73·6	for 1852: 76·6			for 1853: 78·5			for 1854: 77·9			75·4

Isolated months (means), included. 1850: April 76·9; May 93·9. 1855: Jan. 57·5.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
58·4	79·1	88·4	75·8	75·4

SĂRÁULI.

Latitude North.	Longitude East Green.	Height.
28° 30′	79° 10′	(1,200 feet.)

1837-41. BREW. Calcutta Journ. Nat. Hist., IV., p. 423. SR.; and Max.

From my first information I had obtained 700 feet as the height, which made this place apparently too cool in the list I communicated to the Royal Society.

Means.

Months.	1837	1838	1839	1840	1841	General mean.
	Mean of the month.					
January	....	49·1	48·9	53·2	51·4	50·7
February	....	57·3	54·0	57·2	60·0	57·1
March	....	66·0	63·2	69·3	67·2	66·4
April	....	76·5	73·5	77·5	75·0	75·6
May	78·0	79·8	83·5	81·1	82·5	81·0
June	83·1	83·8	88·1	85·8	87·7	85·7
July	85·3	82·3	84·3	85·0	88·6	85·1
August	83·6	80·4	81·0	82·5	88·9	83·3
September	79·6	75·4	77·0	79·7	77·8	77·9
October	74·4	71·0	65·7	70·8	72·3	70·7
November	58·3	56·4	56·7	59·8	60·3	58·3
December	52·1	48·8	54·9	47·3	49·3	56·6
Year	74·3	68·9	69·2	70·8	70·8	70·7

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
54·8	74·3	84·7	69	70·7

SHAHJĒHÁNPUR, in Audh.

Latitude North.	Longitude East Green.	Height.
28° 1'·6	79° 31'·8	(1000 feet.)

1851. Journ. As. Soc., 1852.
1854-5. THOMPSON; SUTHERLAND. SR.; 10; 4; 10.

SCHLAGINTWEIT, "Met Mscr.," Vol. 22.

Months.	1851	1854			General mean.	Months.	1851	1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.			Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	48	60·1	68·8	64·4	56·1	July	86	82·6	88·2	85·4	85·7
February	55½	60·2	66·8	63·5	59·5	August	90	81·8	84·3	83·05	86·5
March	61½	68·4	78·6	73·5	67·5	September	82	80·8	84·9	82·8	82·4
April	72½	80·2	88·0	84·1	78·3	October	78	74·3	79·0	76·6	77·3
May	84·3	84·4	92·5	88·4	86·3	November	68·4	63·5	70·1	66·8	67·6
June	94·8	86·3	91·7	89·0	91·9	December	62·6	58·2	63·8	61·0	61·8

Mean of the years: 1851=73·6; 1854=76·5.

Isolated month (mean). 1855: Jan. 56·0.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
59·1	77·4	88·0	75·8	75·1

Sítapur, in Audh.

Latitude North.	Longitude East Green.	Height.
27° 35′	80° 44′	Ab. 450 feet.

1850. Name illegible, 2nd. Oude L. Inf. SR.; 10; 4; SS. Schlagintweit, "Met. Mscr.," Vol. 21.

1850							
Months.	SR.	4^h P.M.	Mean of the month.	Months.	SR.	4^h P.M.	Mean of the month.
April	68·1	85·8	76·95	August	80·2	85·9	83·05
May	77·0	94·8	85·9	September	76·9	88·5	82·7
June	82·3	92·9	87·6	October	66·8	82·2	74·5
July	82·3	91·6	86·95				

General mean of the seasons and of the year:

June to Aug.
85·9.

Sultánpur, in Audh.

Latitude North.	Longitude East Green.	Height.
26° 15′·6	82° 3′·3♉	Ab. 450 feet.

1850-2. Only isolated months. 2nd. Reg. Audh Loc. Infantry. SR.; 9^h 50^m; 12; 2^h 40^m; 4^h; SS.; Min. Schlagintweit, "Met. Mscr.," Vol. 21.

1851 in Asiat. Journ. too hot, probably because the mean of all the observations was taken.

Months.	SR.	4^h P.M.	Mean.	Months.	SR.	4^h P.M.	Mean.
Jan. 1851	52·1	69·4	60·7	March 1851	62·8	89·3	76·0
Febr. 1851	52·6	77·1	64·8 } 68·3	April 1852	77·7	96·6	87·1
„ 1852	60·8	83·0	71·9 }	July 1851	80·8	90·0	85·4
				Dec. 1850	43·7	74·1	58·9

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·6	....	....	....	....

GROUP IV: PĂNJÁB,

INCLUDING THE STATIONS WEST OF THE INDUS.

Ămbála.	Hoshiárpur.	Multán.
Ásni.	Jălhăndar.	Nakódar.
Bănnu.	Jhílum.	Naushéra.
Dĕra Gházi Khan.	Kartárpur.	Pesháur.
Dĕra Ismáel Khan.	Kohăt.	Raulpíndi.
Firózpur.	Lahór.	Shăhpur.
Govindgărh.	Láya.	Sialkót.
Gugĕra.	Ludhiána.	Vazirabád.
Hánsi.		

The stations of the Pănjáb are situated 7 to 12° north of the Tropic of Cancer. With the Himálaya to the north, and a broad sandy desert to the south over which every breeze from the seas least distant has first to pass, they have a climate differing in means and variations from that of any other part of India.

The cool season is remarkably fresh, the hottest season no longer coincides with our spring but with our summer; and, what is more important still, it is here we find one of the hottest regions of the globe. The rains have lost their tropical character, being reduced to isolated heavy storms; only in autumn we find the Pănjáb to partake of that uniformity of temperature which, spread over 30 degrees of longitude, includes all the northern and central parts of India. For some stations, such as Pesháur and particularly Raulpíndi — which latter may be considered one of the healthiest Indian stations—the elevation of the ground also essentially modifies the climate.

The elaboration and the analysis of the meteorological material presented unexpected results for this province, but they had to be examined with the more precaution; and it was a fortunate thing that such numerous observations could be obtained.

The provincial literature—such as medical, topographical, monographic, statistical accounts—had not appeared, as far as I know, for any of the larger stations, in any form that would allow of my comparing them with those for other provinces. But our own routes in 1856-7, Adolphe's prolonged stay in 1857, and the directions we had given our native medical assistant (Hărkíshen), gave me much personal experience, and also provided me with the necessary materials for judging, from personal inspection, of the accuracy of the observations at the various medical stations. Few only of the materials obtained had to be excluded from the following registers. The greater variation in the yearly means—in which regard, too, the Pănjáb decidedly shows the character of its higher latitude—made it particularly welcome that stations with three years of observation and even more were very numerous.

The *cool season* may be said to begin about the middle of October; it lasts till the beginning of April. The temperature is bracing, refreshing; the mornings are cold, even for Europeans; the height of the sun at noon is still some 40 degrees, the more beneficial as the transparency of the atmosphere approaches that of the Tibetan highlands. The snowy range of the Himálaya frequently becomes visible as far as Ludhiána, a distance of at least a 100 miles, even if we keep in mind that in this season of the year not only the peaks (reaching thousands of feet above the snowline) but also ridges much lower and much nearer the borders present themselves as marked features in the *snowy* aspect. It is not unusual, however, that also periods of a week or more are cloudy; fog is very rare.

In the environs of Pesháur snow has fallen at times, although it disappeared as soon as it came; near Fort Mackeson, about 20 miles distant from the station, a thick coating of snow was seen one morning in the middle of January 1851.—Ice half an inch thick has been observed in ditches; but the regular artificial formation of ice—a few days excepted—requires, even at places such as Raulpíndi, great precaution and care, as detailed in the description of Hindostán.[1]

Such unusual formation of natural ice only takes place on very clear and calm nights.

[1] See p. 236.

Even in Europe exceptional radiation may become more powerful than might be thought. As an instance particularly exceptional I quote the following observation, communicated to me, in 1859, by Mr. QUETELET:

At Audenarde, in Belgium, a coating of ice was found in the ditches of a piece of flat ground outside the doors on the morning of the 16th of June 1841; when brought, at 6 A.M., to the town, it still had the thickness of a sixpenny-piece.[1]

The mornings are frequently passed by Europeans in sport and exercise; and I may mention here the "coffee-shop," a welcome morning club, as characteristic for the social arrangement of these provinces in the cool season. In reference to the scenery of nature, the outlines are grand. Wherever you approach the borders of the Duabs, the vividness of the colours, particularly the blue of the distant profiles, is striking; but it is the green of European landscapes we miss, if it does not happen to be called forth—almost instantaneously, but for a short duration only—by one of the frequent showers of this season. These set in with variable winds, occasionally cold and chilly; but more frequently they are warmer than the atmosphere. Hail also occurs repeatedly in the cool season; in the Lahór registers I found stones mentioned exceeding half an inch in diameter.

The *hot season* and the *rainy season* are not so distinctly separated in the Pănjáb as in lower latitudes. From the end of March the temperature rapidly increases; the end of the month is frequently cloudy and close; at some stations I find remarked that 4 to 6 days occurred without any direct insolation; the wind continues variable, but the north-westerly direction in general prevails. In April the first hot winds, and dust-storms with hot winds, are observed on the south-eastern borders; but the weather may be changeable still in the middle of May, particularly by hailstorms, frequently followed by a very strong depression of temperature. In 1853, May 13th, a heavy hail came down with storm from the coast, from Lahór to Ferózpur; the temperature at Lahór fell to 64° Fahr., at Sialkót even to 59° Fahr.; the rain is noted = $1^3/_4$ inches at Lahór in 2 days, "a quantity rather exceptional for this month."

Still up to June, unless a very cloudy sky interferes, the mornings and evenings are comparatively cool, but later the daily variation is very much reduced. At Áttok, June 27, 1855, the temperature was 110° at 8^h A.M. July is the

[1] Snow fell unusually late at Berlin that year (1841)—the 29th of May, at about 10^h P.M.

month of greatest rain, with thunderstorms, but 4 to 6 inches all the month are unusual for the northern parts. The rain, however, by its violent and sudden precipitation, makes itself more felt; the country also becomes more frequently flooded than might be expected from the quantity fallen. Four days of rain at Lahór, July 20 to 24, are called here "a season such as has not been enjoyed for years, in this part of the Pănjáb at least;" in the environs of Déra Ismáel Khan heavy steamy fogs preceded those rains in the middle of July. Isolated rains and hailstorms are also observed in June, but dust-storms without rain are more numerous; for the northern and western parts the total amount of rain is altogether very limited, and the greater part of it comes down in the cool season.

As the heat increases the more regularly dust-storms occur, with variable direction, not unfrequently beginning with full power after a calm of several days, when the surface of the ground has become sufficiently heated. A phenomenon peculiar enough, but I think not yet sufficiently noticed, is the circumstance, that the hot wind, whatever may be its direction, diminishes considerably in power after sunset; only later in the season, when the temperature remains nearly the same all night, it continues steady. In Hindostán, especially when approaching Bengál, it regularly ends half a hour to an hour after sunset; or, as I shall have occasion to detail when examining the *mean directions calculated*, it continues at some height above the ground; and, in favourable nights, with delicate instruments,[1] even in the hot season, a mild south-easterly counter-current may be observed along the ground. I also allude to it as it is somewhat analogous to that general stream of the rainy *monsun* rushing up through Hindostán to compensate for the volumes of air ascending from that Indian funnel, the Pănjáb, during the months which *there* are the hottest.

In the hot weather tents give but a very insufficient protection; even when double-roofed the direct rays of the sun produce an accumulation of heat not without analogy with that behind the glasses of a wall-case; and gradually so high a temperature radiates from the inner surface of the tent that it becomes easily perceptible to the raised hand which of its two sides is the nearer to the tent covering; a thermometer in the tent then regularly stands a little lower when hung up still under an umbrella for protection against the radiating heat. In houses wetted tatties—air being artificially thrown against them by revolving wheels (thermantidots)—combined

[1] Compare "Phys. Geogr. of the Alps," Vol. I., p. 394.

with a most careful exclusion of glare, at times considerably reducing the light, are the protections used. It is surprising to see how backward in this respect the houses of the natives, even those of the highest rank, were before Europeans had introduced their experiments.

Nevertheless, the temperature rises high enough even inside the houses; I quote some observations communicated, by Colonel SYKES.[1]

On the 22nd of May 1849, at Ferózpur, latitude 30° 53′, on the Sátlej river, the thermometer stood at 104° Fahr. in a good house, the usual precautions being taken against the hot winds. Even in August, at Pesháur, with thunderstorms and heavy rain on the 7th, 9th, 15th, 16th, 17th, 20th, and 29th, and with several light showers besides, the maximum was 104° Fahr. at 4 P.M., the minimum at sunrise 81° Fahr., the midday maximum 101° Fahr., and with a midnight maximum of 100° Fahr.; and yet the Report says, "The month had not, however, been characterized, as would be supposed by the indications of the thermometer, by any unusual degree of heat *over those which had just preceded it.* It even did not range so high as in May, June, and July."

For Bagdad (Lat. N. 33° 20′; Long. E. Gr. 44° 24′), Col. SYKES, communicates observations, by Dr. WALLIN, which approach the Indian type of the hot season and even fully reach the maxima there observed. Dr. WALLIN's thermometer was put up in the shade of a house, outside, on the second story with a northwest aspect on the banks of the Tigris. His readings were on the 19th of July 1848 at 2^h P.M. 122°·9 Fahr., wind W.N.W.; on the 13th and 18th 120°·2; and on seven other days in the month of July 118°·4; the lowest heat in the month at 2^h P.M. was 101°·3 on the second of July, wind N.W., clear.

Isolated maxima, even means of 2 to 3 hours, we know may become very high in Europe too, but generally we do not keep in mind for comparison that the daily means already differ very much, most of all the monthly means. The *means* are to be kept in view as characteristic for the regions of extreme heat in India. Indian heat sometimes continues for weeks, with an extremely small daily variation. Maxima of about 125° Fahr. seem to be the highest which can be expected, at least

[1] Phil. Trans., 1850, P. II., p. 329. At the close of March, as General JACOB communicated to me in 1863, he had in a large tent, east of Kăch, 110° Fahr.

when glare and radiation from lateral objects are excluded; and they are very rare even in the deserts of Africa, where, besides, the mean of the day is considerably lowered by the rapid decrease after sunset.[1]

In the southern parts, approaching Rajvára, the phenomena of heat are about the same; the quantity of rain is still considerably less and its distribution môre irregular; in 1854 from May to November only four showers of rain fell at Multán. The mean of the year at this station is the hottest of all the Pănjáb, 76·8° Fahr.; the mean for June, July, and August 92·0° Fahr. is only exceeded by that of Déra Ismáel Khan (93·9) and Sháhpur (93·0); but the single months June and July are hotter at many of the stations higher up than at Multán.

In *Autumn* the breaking up of the heat is coincident with storms and rains; it is the temperature of the surface of the ground which is then materially altered; and as soon as such storms occur—which are spread over a large surface—the depression may become very sudden and very great. At Lahór, the 8th of October 1855 the temperature had sunk 16° Fahr. after some storms—first with dust still, but soon with heavy rain—had passed along the valley of the Rávi. From October to December the temperature decreases very rapidly; a difference between the monthly means of 8° to 10° Fahr. is very frequent. Miasms are much less malignant than in Hindostán and Bengál, although the towns of the Pănjáb, especially Lahór and Amrítsăr, are extremely filthy in the quarters occupied by the natives.

The *absolute extremes* are taken from the observations by Dr. Dembster, Dr. Turnbull, and Dr. Jones at Ludhiána.

The *mean insolation* I took from the Parl. San. Rep., Dr. Tritton's observations at Ambála (1851-52), and Dr. Cardew's registers at Ferózpur; they are the mean for the period from 1855 to 1859. In the hot months they are above those of Hindostán, but as detailed before they remain below those along the Indian coasts.[2]

[1] This was, amongst many others, one of the very important meteorological results of Dr. Barth's observations in Africa.

[2] For the "daily variation" in the Pănjáb see pp. 88 and 89; for the "variability," p. 128.

Absolute Extremes
from observations at Ludhiána.

Months.	Extremes. Min.	Extremes. Max.	Months.	Extremes. Min.	Extremes. Max.
January	31	69	July.	60	97
February	42	81	August	83	100
March.	46	82	September	63	98
April	56	96	October.	52	95
May.	68	105	November	42	84
June	68	111	December.	32	70

From stations where the extremes have been noted less regularly, but where the maxima (coinciding with the more central position in the region of greatest heat) are considerably higher, I quote, for July:

Déra Ismáel Khan	116
Guzéra	122

Mean Insolation
from observations at Ambála and Ferózpur.

Months.	Ambála.	Ferózpur.	Months.	Ambála.	Ferózpur.
January	89	95	July.	122	130
February	95	98	August	122	115
March	91	103	September	126	108
April	104	115	October	128	118
May	113	130	November	100	96
June	117	125	December	89	79

Plates to be compared:

Valley of the Biás at the crossing between Amrítsăr and Jelínder, a bright and brilliant January aspect, the ground is still rather barren. Or. No. 182, Part IV., No. 23a.

The *Jhilum river* with the salt range in the distance; though in the cool season a slight haze of dust is spread over the country and the lower parts of the horizon. Or. Nr. 184, Part IV., No. 23b.

Drift sands in the Interior of the Sindh Ságer Duáb, and *Alluvial High ground* on the border. Part I., No. 6, a and b.

AMBÁLA.

Latitude North.	Longitude East Green.	Height.
30° 21′·4	76° 48′·8	1026 feet.

1850-56. TRITTON. Particularly detailed and careful, also observations of a very good barometer. Hours of observations: 1850, SR.; 10; 4; SS. 1851-56: SR.; 9h 50m; 12; 2h 40m; 4h; SS.; Min.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 26.

Months.	1850			1851			1852			1853			1854			1855			1856			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	....	.....	....	52·3	60·1	56·4	43·7	64·7	54·2	45·4	60·0	52·7	42·7	68·5	55·6	40·7	59·7	50·2	47·8	67·9	57·8	54·5
Febr.	....	.....	....	59·4	65·9	62·6	55·5	74·7	65·1	52·0	73·0	62·5	45·5	64·4	54·9	46·9	72·3	59·6	48·6	74·2	61·4	61·0
March	....	.....	....	....	....	73·2	57·4	72·7	65·0	59·6	83·0	71·3	55·0	80·1	67·5	55·7	75·9	65·8	63·6	89·5	76·5	69·9
April	72·9	82·1	77·5	....	....	81·2	65·1	87·4	71·2	71·0	88·8	79·9	67·1	93·9	80·5	64·8	86·1	75·4	69·6	97·1	83·3	78·4
May	80·9	86·3	83·6	....	....	87·9	73·6	94·0	80·7	74·3	96·5	85·4	72·9	98·9	85·9	77·9	103·5	90·7	80·4	102·8	91·6	86·5
June	81·1	108·5	94·8	83·0	99·7	91·3	80·0	96·7	88·3	82·6	99·9	91·2	84·3	100·4	92·3	84·7	103·7	94·2	78·7	92·5	85·6	91·1
July	86·4	101·1	93·7	79·7	89·4	84·5	79·3	89·7	84·5	79·5	87·9	83·7	80·2	91·8	86·0	79·2	88·2	83·7	80·6	88·9	84·7	85·8
Aug.	78·1	95·6	86·8	80·7	92·7	86·7	78·1	86·7	82·4	80·6	94·2	87·4	78·7	90·0	84·3	79·3	94·3	86·8	....	....	....	85·7
Sept.	74·9	100·0	87·4	77·7	95·5	86·6	78·4	89·7	84·0	78·6	92·0	85·3	76·0	86·1	81·0	74·4	88·2	81·3	....	....	....	84·3
Oct.	62·5	100·6	81·5	65·7	89·4	77·5	64·1	85·9	75·0	62·6	81·2	71·9	61·1	80·7	70·9	60·6	86·2	73·4	....	....	....	75·0
Nov.	48·7	87·4	68·0	50·7	71·2	60·9	55·2	73·8	64·5	52·4	75·7	64·0	46·9	72·3	59·6	47·8	76·5	62·1	....	....	....	63·2
Dec.	45·3	78·1	61·7	45·7	67·1	56·4	44·6	64·7	54·6	40·8	68·2	54·5	47·1	63·3	55·2	41·6	68·3	54·9	....	....	....	56·2
Year			....	for 1851: 75·4			for 1852: 72·5			for 1853: 74·1			for 1854: 72·8			for 1855: 73·2					....	74·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
57·2	78·3	87·5	74·2	74·3

AMRÍTSĂR, *see* GOVINDGHĂR.

ÁSNI.

Latitude North.	Longitude East Green.	Height.
29° 12′	70° 7′	Ab. 410 feet.

1853. DELPRATT. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 32.

1853.							
Months.	SR.	4^h P.M.	Mean of the month.	Months.	SR.	4^h P.M.	Mean of the month.
January	40	64	52	June	85	100	93
February	48	74	61	July	84	96	90
March	59	82	70½	August	80	93	86½
April	69	89	79	September	78	94	86
May	75	97	86	October	60	85	72½

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
. . . .	78·5	89·8	. . . .	. . . .

Bȧnnu.

Latitude North.	Longitude East Green.	Height.
32° 40′	70° 30′	Ab. 1,800 feet.

1852-54. Maxwell, Delpratt, Nutty. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 32.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	....	....	42	55	48·5	42	59	50·5	49·5
February	....	....	....	51	65	58·0	46	58	52·0	55·0
March	....	....	....	58	75	66·5	54	69	61·5	64·0
April	....	....	....	66	84	75·0	65	81	73·0	74·0
May	....	....	....	74	93	83·5	74	88	81·0	82·0
June	....	....	....	85	104	94·5	87	96	91·5	93·0
July	....	....	....	86	98	92·0	84	96	90·0	91·0
August	82	92	87·0	82	94	88·0	84	97	90·5	88·5
September	79	94	86·5	79	93	86·0	79	94	86·5	86·3
October	68	86	77·0	67	84	75·5	64	81	72·5	75·0
November	58	74	66·0	56	77	66·5	53	71	62·0	64·8
December	46½	61	53·7	50	62	56·0	48	63	55·5	55·1
Year			.....	for 1853: 74·2			for 1854: 72·2			73·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
53·2	73·3	90·8.	75·4	73·2

DÉRA GHÁZI KHAN.

Latitude North.	Longitude East Green.	Height.
30° 0′	70° 54′	200 feet.

1852-4, 1856. IRWIN; FLEMING; NUTTY; MAXWELL. SR.; 10; 4; SS. The four months of 1856 had been copied without the observer's name being mentioned.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 32.

Months.	1852			1853			1854			1856			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	35	62	48·5	40	63	51·5	43	54	48·5	47	68	57·5	51·4
Febr.	58	68	63·0	46	70	58·0	45	65	55·0	50	76	63·0	59·7
March	60	75	67·5	57	74	65·5	56	77	66·5	63	89	76·0	68·9
April	61	89	75·0	64	87	75·5	70	92	81·0	70	96	83·0	78·6
May	75	97	86·0	75	93	84·0	..	...	(85)	..	..	....	85·2
June	85	101	93·0	86	100	93·0	91	100	95·5	..	..	....	93·8
July	83	97	90·0	85	94	89·5	90	99	94·5	..	..	....	91·3
Aug.	78	92	85·0	82	95	88·5	87	96	91·5	..	..	....	88·3
Sept.	77	96	86·5	76	94	85·0	79	95	87·0	..	..	....	86·2
Oct.	63	83	73·0	60	82	71·0	60	82	71·0	..	..	....	71·7
Nov.	53	78	65·5	55	75	65·0	48	72	60·0	..	..	....	64·5
Dec.	49	60	54·5	47	66	56·5	47	64	55·5	..	..	....	55·5
Year	for 1852: 74·0			for 1853: 73·6			for 1854: 74·2					.....	74·6

Isolated months (means). 1851: Nov. 67·5; Dec. 55·5. 1855: Jan. 51.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
55·5	77·6	91·1	74·1	74·6

DÉRA ISMÁEL KHAN.

Latitude North.	Longitude East Green.	Height.
31° 39′·6	70° 56′·5	478 feet.

1852-4. HARRISON; WALLICH. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 32.

Months.	1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	....	....	....	42·3	55·8	49·0	....	....	....	(49·0)
February	....	....	....	57	67	62	50·2	60·2	55·2	58·6
March	....	....	....	62	78	70	....	....	....	(70·0)
April	....	....	....	72	84	78	72	88	80·0	79·0
May	....	....	....	82	93	87·5	78	93	85·5	86·5
June	....	....	....	89	102	95·5	87	100	93·5	94·5
July	93	99	96	90·5	100	95·2	....	....	....	95·6
August	86	96	91	87	97	92·0	....	....	....	91·5
September	86	94	90	....	.....	....	....	....	....	(90·0)
October	72	85	78·5	76	92	84·0	....	....	....	81·2
November	57	70	63·5	62	79	70·5	....	....	....	67·0
December	46	57	51·5	49	59	54·0	....	....	....	52·7
Year			....			....			....	76·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
53·4	78·5	93·9	79·4	76·3

Firózpur.

Latitude North.	Longitude East Green.	Height.
30° 57′·1	74° 38′·4	1,120 feet.

1850-4. Rae; Grey. SR.; $4^h\ 50^m$; 12; $2^h\ 40^m$; 4; SS.: SR.; 10; 4; 10.
Schlagintweit, "Met. Mscr.," Vol. 31.

1851. Journ. As. Soc.; left out on account of great and irregular differences.

1855-9. For this period the Parl. San. Rep., Vol. II., p. 163, give a mean of 77·9; but the hours being not detailed I left this series out, as particularly for regions where the daily variation is so great the combination of the hours is of more than ordinary importance.

General mean of the months.

Months.	1850/51			1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	43	59	51·0	36	63	49·5	38	57	47·5	49	60	54·5	51·0
February	48	67	57·5	47	73	60	44	71	57·5	55	63	59·0	58·5
March	61	80	70·5	53	73	63	52	80	66·0	63	73	68·0	66·9
April	63	96	79·5	61	86	73·5	60	88	74·0	76	87	81·5	77·1
May	70	100	85·0	69	89	79	68	94	81·0	82	92	87·0	83·0
June	83	100	91·5	78	95	86·5	80	102	91·0	91	100	95·5	91·1
July	83	93	88·0	82	94	88	82	95	88·5	85	92	88·5	88·2
August	80	91	85·5	74	87	80·5	80	101	90·5	85	93	89·0	86·4
September	75	95	85·0	73	92	82·5	76	99	87·5	82	91	86·5	85·4
October	60	89	74·5	56	85	70·5	60	84	72·0	72	81	76·5	73·4
November	46	77	61·5	48	74	61	..	..	....	56	72	64·0	62·2
December	41	65	53·0	35	63	49	..	..	....	53	65	59·0	53·7
Year	for 1850/51: 73·5			for 1852: 70·2					....	for 1854: 75·7			73·1

Isolated month (mean). 1855: Jan. 52·6.

General mean of the season and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
54·4	75·7	88·6	73·7	73·1

Govindgárh, close to Amrítsăr.

Latitude North.	Longitude East Green.	Height.
31° 40′	74° 45′	Ab. 900 feet.

1852-4. General means, based on SR. and 4. Schlagintweit, "Met. Mscr.," Vol. 31 (Rain in Vol. 29).
1857-9. Parl. San. Rep., Vol. II., p. 189. Hours not mentioned; probably too warm (about 3°) from arbitrary combination of hours or imperfect protection of the instruments against radiation.

1852-4. Mean of the month.			
January	51·0	July	85·5
February	56·0	August	84·0
March	64·7	September	83·5
April	73·2	October	76·5
May	81·2	November	63·2
June	85·3	December	55·5

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
54·2	73·0	84·9	74·4	71·6

Gugéra.

Latitude North.	Longitude East Green.	Height.
30° 51′	73° 0′	Ab. 600 feet.

1851. Journ. As. Soc., 1852, p. 383, and Sykes, British Assoc. for 1852. No details known. There it is given: Goojarea.

1851. Mean of the month.			
January	50	July	....
February	59	August	89·5
March	69½	September	82
April	77½	October	....
May	90	November	58
June	95½	December	....

Mean. March, April, May: 79.

HÁNSI.

Latitude North.	Longitude East Green.	Height.
29° 6′·1	75° 57′·1♁	Ab. 1000 feet.

1850-51, and 1855, May and June. THRING; HILLIARD. The monthly values can only be considered as approximations. The instruments were not very regularly read, but they seem to have been very well put up. SCHLAGINTWEIT, "Met. Mscr.," Vol. 24.

Mean. 1851 and 50.

Jan.	1851	55·5	April	1851	88·1	1855	Mean	July	1851	86	Oct.	1851	72
Febr.	,,	62·0	May	,,	95·7	95·2	95·4	Aug.	,,	82	Nov.	,,	65
March	,,	71·5	June	,,	94·0	99·9	96·9	Sept.	,,	79·8	Dec.	1850	57·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
58·3	85·0	88·3	72·3	76·0

HOSHIÁRPUR.

Latitude North.	Longitude East Green.	Height.
31° 32′·2	75° 53′·9♁	1,066 feet.

1851-4. MACASH; STROVER. Means based on SR. and 4. SCHLAGINTWEIT, "Met. Mscr.," Vol. 31.

Months.	Mean of the months.			General mean.	Months.	Mean of the months.			General mean.
	1851.	1852.	1854.			1850.	1852.	1854.	
January	49·6	54·8	57·3	53·9	July	86·0	86·6	86·1	86·2
February	57·0	63·9	56·0	59·0	August	85·6	83·4	85·1	84·7
March	68·8	64·4	....	66·6	September	....	84·6	83·7	84·1
April	81·3	....	79·7	80·5	October	78·4	....	....	(78·4)
May	....	85·4	85·1	85·2	November	61·6	....	64·4	63·0
June	1850 93·2	91·3	91·7	92·1	December	55·1	....	58·0	56·5
					Year	....	....	....	74·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
56·5	77·4	87·7	75·2	74·2

JĂLHĂNDAR.

Latitude North.	Longitude East Green.	Height.
31° 19′·5	75° 33′·3♉	Ab. 900 feet.

1852-4. Reid; Boye. SR.; 9; 12; 2; 4; SS. (1851, Journ. As. Soc., left out, being quite irregular.)

Schlagintweit, "Met. Mscr.," Vol. 31.

Months.	1852			1853			1554			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	42	61	51·5	51·3	54·8	53·0	51·6	60·2	55·9	53·5
February	55	72	63·5	....	....	....	53·3	58·2	55·7	59·6
March	58·5	70·6	64·5	65·3	75·0	70·1	61·3	70·7	66·0	66·9
April	68·8	79·6	74·2	72·6	80·9	76·7	72·4	84·4	78·4	76·4
May	78·7	85·0	81·8	78·4	84·8	81·6	78·4	83·9	81·1	81·5
June	82·0	88·2	85·1	86·6	91·1	88·8	87·3	89·2	88·2	87·4
July	86·3	88·9	87·6	84·3	89·1	86·7	83·2	89·4	86·3	86·9
August	82·9	84·1	83·5	....	....	....	82·8	88·0	85·4	84·4
September	....	....	....	....	....	....	81·3	86·6	83·9	(83·9)
October	69·9	81·9	75·9	....	....	....	....	....	....	(75·9)
November	62·1	71·4	66·7	....	....	....	60·4	68·8	64·6	65·6
December	54·6	60·7	57·6	....	....	....	56·2	60·2	58·2	57·9
Year			....			....			....	73·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
57·0	74·9	86·2	75·1	73·3

JHÍLUM.

Latitude North.	Longitude East Green.	Height.
32° 55′·2	73° 42′·0 ♉	1,620 feet.

1852-4. JOHNSON; DAVIDSON; HANNAY; NISBET. SR.; 9^h 50^m; 12; 2^h 40^m; 4^h; SS.: and SR.; 10; 4; SS.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 29.

As. Soc. for 1851 left out, being too hot (and besides very incomplete).

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	41·1	59·8	50·45	....	....	....	....	....	....	(50·45)
February	52·3	69·6	60·95	46·5	67·8	57·15	47·6	64·4	56·0	58·0
March	54·2	67·1	60·65	54·5	79·0	66·7	60·6	76·0	68·3	65·2
April	62·6	82·4	72·5	60·0	84·1	72·05	71·6	79·3	75·45	73·3
May	....	....	....	76·1	93·0	84·55	78·9	85·7	82·3	83·4
June	82·5	102·2	92·35	80·4	102·2	91·3	88·3	93·6	90·95	91·5
July	82·2	96·7	89·45	79·9	93·3	86·6	82·6	88·8	85·7	87·25
August	76·2	86·1	81·15	....	....	....	85·6	92·8	89·2	85·2
September	80	87	83·5	....	....	....	82·1	90·7	86·4	84·95
October	69·5	82·2	75·85	....	....	....	69·4	76·9	73·15	74·5
November	65·5	72·7	69·1	....	....	....	55·2	65·1	60·15	64·6
December	45·6	61·7	53·65	....	....	....	38·4	50·5	44·45	49·05
Year			....			....			.....	72·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
52·5	74·0	88·0	74·7	72·3

KOHÁT.

Latitude North.	Longitude East Green.	Height.
33° 32′·5	71° 22′·9	1,725 feet.

1851. Journ. As. Soc., 1852.

1852-6. Moss, DEANE, and since 1844, WALLICH. The observations of the latter were very detailed and careful, and the correctness of his instruments was ascertained by comparison with ADOLPHE's instruments. SR.; $9^h\ 50^m$; 12; $2^h\ 40^m$; 4^h; SS.: and SR.; 10; 4; 10; Max. Min.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 32.

Months.	1851	1852			1854			1855	1856			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	50·5	43·0	57·3	50·1	46·2	59·2	52·7	51·7	48·8	59·0	53·9	51·8
Febr.	58·5	....	....	....	....	....	....	59·2	54·3	67·0	60·6	59·4
March	67·3	73·9	67·8	70·8	....	....	....	63·7	66·0	80·3	73·1	68·7
April	77·7	....	....	....	....	....	....	71·7	71·0	85·9	78·4	75·9
May	88·0	....	....	....	....	....	....	84	80·4	96·1	88·2	86·7
June	93·0	....	....	....	....	....	....	89	84·5	99·4	91·9	91·3
July	92·1	....	....	....	85·5	92·6	89·0	86½	86·5	98·1	92·3	90·0
Aug.	90·4	....	....	....	85·3	93·8	89·5	86	81·6	87·4	84·5	87·6
Sept.	....	....	....	....	82·3	92·7	87·5	86	....	....	....	86·7
Oct.	....	....	....	....	....	....	....	78	....	....	....	(78)
Nov.	57·9	....	....	....	58·2	73·0	65·6	63	....	....	....	62·2
Dec.	58·0	....	....	....	52·0	64·8	58·4	56½	....	....	....	57·6
Year				....			....	72·9			....	74·7

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
56·3	77·1	89·6	75·6	74·7

Katrárpur.

Latitude North.	Longitude East Green.	Height.
31° 26′·7	75° 29′·1±	Ab. 800 feet.

1851 and 1852. Davidson. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 26.

Nov. and Dec. interpolated, to obtain the means, from analogy with neighbouring stations.

Months.	1851			1852			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	53·4	60·8	57·1	50·1	64·0	57·0	57·0
February	56·7	63·1	59·9	58·9	66·9	62·9	61·4
March	64·4	74·9	69·6	62·8	68·1	65·4	67·5
April	74·2	86·7	80·4	67·7	78·1	72·9	76·6
May	82·7	96·1	89·4	78·7	88·3	83·5	86·4
June	88·4	97·9	93·1	84·8	93·1	88·9	91·0
July	84·4	89·2	86·8	85·3	91·2	88·2	87·5
August	85·4	93·5	89·4	82·5	87·0	84·7	87·0
September	83·6	95·9	89·7	82·2	92·9	87·5	88·6
October	73·5	88·1	80·8	68·1	88·7	78·4	79·6
November	....	....	....	....	....	(69)	(69)
December	....	....	....	....	....	(60)	(60)
Year			....	for 1852: 74·7			76·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
59·5	76·8	88·5	79·1	76·0

Lahór and Mianmír.

	Latitude North.	Longitude East Green.	Height.
Lahór:	31° 31′·1	74° 14′·6	839 feet.

1851-6. Of Lahór and the military station Mianmír, in its immediate vicinity, I had 6 different series of observations, of which the 8th. light cavalry station at Anarkálli extended over the longest period—from April 1851 to December 1857. Also the artillery station at Mianmír was very complete and carefully observed. I took the general means, excluding, however, those observations which deviated irregularly, even if not very much, from all the others. The names of the principal observers are: Cunningham, Dopping, McLines, Patton, Rae. The hours were: SR.; 10; 4; SS.: SR.; 10; 4; 10; Max.; Min. Schlagintweit, "Met. Mscr.," Vol. 30.

Months.	1851			1852			1853			1854			1855			1856			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	40·0	67·6	53·8	39·1	66·9	53·0	39·4	60·2	49·8	39·5	65·0	52·2	34·1	60·5	47·3	50·8	64·8	57·8	52·3
Febr.	48·1	71·3	59·7	50·5	75·3	62·9	48·4	74·3	61·3	45·4	62·7	54·0	42·4	77·8	60·1	54·2	78·7	66·4	60·7
March	57·0	81·8	69·4	56·5	73·8	65·1	54·4	83·6	69·0	54·2	78·1	66·1	52·4	72·1	62·2	64·0	92·3	78·1	68·3
April	68·8	90·3	79·5	67·0	85·8	76·4	72·4	79·8	76·1	66·6	94·2	80·4	....	....	....	67·3	94·4	80·8	78·6
May	77·0	99·5	88·2	73·7	91·5	82·6	78·3	96·7	87·5	74·1	100·2	87·1	....	....	....	81·1	99·7	89·9	87·1
June	85·0	101·5	93·2	83·7	95·5	89·6	....	....	....	85·4	108·1	96·7	....	....	....	80·6	98·4	89·5	92·2
July	81·1	89·5	85·3	84·9	94·7	89·8	....	....	....	80·6	95·8	88·2	80·7	89·6	85·1	79·3	100·0	89·6	87·6
Aug.	81·6	91·2	86·4	79·5	85·6	82·5	....	....	....	80·7	98·5	89·6	83·6	88·2	85·9	79·7	95·6	87·6	86·4
Sept.	77·5	94·6	86·0	79·1	92·7	85·9	....	....	....	77·3	94·8	86·0	81·8	85·9	83·8	79·3	94·0	86·6	85·7
Oct.	64·9	87·5	76·2	66·8	87·2	77·0	....	....	....	63·2	84·2	73·7	....	....	....	67·9	94·3	81·1	77·0
Nov.	54·0	76·0	65·0	56·3	70·9	63·6	....	....	....	53·3	75·3	64·3	....	....	....	63·8	81·8	72·8	66·4
Dec.	41·4	70·5	55·9	40·0	68·5	54·2	....	....	....	44·1	65·4	54·7	....	....	....	55·2	76·9	66·0	57·7
Year	for 1851: 74·9			for 1852: 73·5					....	for 1854: 74·4					....	for 1856: 78·9			75·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
56·9	78·0	88·7	76·4	75·0

LÁYA.

Latitude North. 30° 59′ Longitude East Green. 70° 57′ Height. Ab. 450 feet.

1852-5. Native sub-assistant Surgeon.* SR.; 9^h 50^m; N.; 2^h 40^m; 4; SS.: SR.; 10; 4, SS.; 4.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 32.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	52·7	58·3	55·5	42·8	53·9	48·3	41·6	53·7	47·6	49·5
February	59·3	66·1	62·7	54·3	63·7	59·0	51·6	60·6	56·1	59·3
March	65·5	70·2	67·8	62·6	71·7	67·1	60·6	69·1	64·8	66·6
April	74·3	79·7	77·0	72·0	80·7	76·3	71·5	80·7	76·1	76·5
May	81·2	87·2	84·2	78·8	88·1	83·4	77	87	82·0	83·2
June	89·6	96·2	92·9	86·7	95·2	90·9	86	98	92·0	91·9
July	87·7	92·7	90·2	85·4	92·0	88·7	84	90	87·0	88·6
August	80·6	85·9	83·2	83·8	90·1	86·9	84	91	87·5	85·9
September	78·9	88·4	83·6	79·7	88·0	83·8	79	89	84·0	83·8
October	61·1	76·8	68·9	62·0	72·7	67·3	76	81	78·5	71·6
November	54·1	68·2	61·1	51·8	61·9	56·8	53	64	58·5	58·8
December	44·4	56·9	50·6	....	....	....	45	56	50·5	50·5
Year	for 1852: 73·1					....	for 1854: 72·0			72·2

Isolated month (included in the mean). 1855: Jan. 46·5.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
53·1	75·4	88·8	71·4	72·2

Ludhiána.

Latitude North. 30° 55′·4 | Longitude East Green. 75° 50′·2 ♉ | Height. 893 feet.

1851. Journ. As. Soc., 1852, and isolated originals, by Clark.

1852-3. Dempster; Hunter; Clark; Turnbull; Jones; SR.; $9^h\ 50^m$; N.; $2^h\ 40^m$; 4^h; SS.

Schlagintweit, "Met. Mscr.," Vol. 31.

Months.	1851			1852			1853			General mean.
	SR.	4^h P. M.	Mean of the month.	SR.	4^h P. M.	Mean of the month.	SR.	4^h P. M.	Mean of the month.	
January	....	....	....	....	....	....	48	55	51·5	(51·5)
February	....	....	61·0	48·2	72·8	60·5	57½	70·3	63·9	61·8
March	....	....	70·2	52·8	71·4	62·1	65·3	76·8	71·0	67·8
April	....	....	81·9	60·0	83·8	71·9	73·2	83·6	78·4	77·4
May	....	....	90·5	70	89	79·5	79·5	88·6	84·0	84·7
June	....	....	92·9	78	95	86·5	88·4	98·8	93·6	91·0
July	....	....	86·1	79	91	85·0	84·0	91·9	87·9	87·8
August	....	....	88·4	78	87	82·5	87·9	97·2	92·5	87·8
September	74·4	93·6	84·0	71	89	80·0	85·6	95·4	90·5	84·8
October	58·4	88·4	73·4	....	....	....	71·5	83·1	77·3	75·3
November	....	....	....	....	....	....	....	....	....	....
December	38·4	68·4	53·4	....	....	....	....	....	....	(53·4)

Isolated month (mean). 1850: June 92·4.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
55·6	76·6	88·9	....	....

MULTÁN.

Latitude North.	Longitude East Green.	Height.
30° 10′·2	71° 34′·6	480 feet.

1852 and 1853. MORRIESON. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 32.

The means for 1851 from Journ. As. Soc. were excluded, being too warm, probably in consequence of the improper combination of the series.

Months.	1852			1853			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	..	...	....	48	65	56½	(56½)
February	..	...	....	56	66	61	(61)
March	..	...	....	60	74	67	(67)
April	..	...	....	74	86	80	(80)
May	80	88	84·0	81	90	85½	84·7
June	89	100	94·5	88	99	93½	94·0
July	85	96	90·5	90	97	93½	92·0
August	85	93	89·0	86	96	91	90·0
September	83	91	87·0	84	94	89	88·0
October	72	83	77·5	74	87	80½	79·0
November	65	73	69·0	65	79	72	70·5
December	46	73	59·5	..	..	....	59½
Year			....			....	76·8

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
59·0	77·2	92·0	79·2	76·8

Nakódar.

Latitude North. 31° 7′ | Longitude East Green. 75° 27′ | Height. Ab. 840 feet.

1852-5. Greig. SR.; 10; 4; SS.
Schlagintweit, "Met. Mscr.," Vol. 31.

1851, Journ. As. Soc. left out, except February, to complete the year, being decidedly too hot from April.

Months.	1852 SR.	1852 4h P.M.	1852 Mean of the month.	1853 SR.	1853 4h P.M.	1853 Mean of the month.	General mean.
January	....	....	....	51·4	56·5	53·9	(53·9)
February	....	....	....	....	....	....	(61)
March	62·2	71·3	66·7	67	77·2	72·1	69·4
April	71·8	82·6	77·2	74·8	85·4	80·1	78·6
May	79·3	90·8	85·0	....	....	....	85·0
June	82·6	96·5	89·5	89·3	99·1	94·2	91·8
July	85	93·5	89·2	85·4	92·3	88·8	89·0
August	82	87	84·5	....	....	....	(84·5)
September	81·2	90·2	85·7	....	....	....	(85·7)
October	71·9	83·1	77·5	....	....	....	(77·5)
November	63·9	72·6	68·2	....	....	....	(68·2)
December	52·8	62·8	57·8	....	....	....	(57·8)

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
57·6	77·6	88·4	77·1	75·2

Naushéra.

Latitude North. 34° 3′·1 | Longitude East Green. 71° 58′·45 | Height. Ab. 1,200 feet.

1854. Littler. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 32.

The probable value was added for October to obtain the means.

1854. Means of the month.							
Months.	SR.	4^h P.M.	Mean of the month.	Months.	SR.	4^h P.M.	Mean of the month.
January	37·7	64·6	51·1	July	82·7	99·7	91·2
February	42·0	60·3	51·1	August	79·5	100·0	89·7
March	49·0	73·9	61·4	September	76·8	95·1	85·9
April	59·1	88·9	74·0	October	....	....	(74)
May	68·3	95·5	81·9	November	46·2	69·0	57·6
June	79·7	110·7	95·2	December	39·5	72·5	56·0
				Year	....	....	72·4

Isolated month (mean). 1855: Jan. 43·6, included in the mean.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
51·5	72·4	92·0	72·5	72·1

Pesháur.

Latitude North.	Longitude East Green.	Height.
34° 3′·2	71° 33′·35	1,280 feet.

1851. Journ. As. Soc., 1852.

1852-4. For this period I had the opportunity of comparing and combining numerous series of observations, made near the different barracks and hospitals of this large cantonment. The names of the principal observers are: Adams, Baddeley, Buckle, Coghlan, Crawford, Currie, Dartnell, Davidson, Forghar, Grant, James, besides several others connected only with smaller series. The numbers I present are means of the best series selected. The hours of observation were partly SR.; 9h 50m; 12; 2h 40m; 4h; SS.; partly SR.; 10; 4; 10; and Min. Adolphe, during his stay at Pesháur, had occasion to obtain valuable information in reference to the instruments in use and to the mode of the observations.

Schlagintweit, "Met. Mscr.," Vol. 28.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	48·8	44·0	57·0	50·5	46·3	53·3	49·8	51·1	69·0	60·0	52·3
February	....	52·1	67·0	59·5	52·5	61·4	56·9	52·3	57·4	54·8	57·1
March	....	56·0	66·0	61·0	60·3	69·4	64·8	56·8	66·4	61·6	62·5
April	....	64·0	78·3	71·1	67·1	79·1	73·1	71·1	80·0	75·5	73·2
May	....	74·5	86·1	80·3	79·4	87·0	83·2	76·4	82·9	79·6	81·0
June	....	82·5	98·0	90·2	80·5	96·0	88·2	88·2	95·8	92·0	90·1
July	95·5	86·7	101·0	93·8	85·5	95·6	90·5	82·5	92·8	87·6	91·8
August	88·7	82·0	93·5	87·7	84·0	93·1	88·5	84·4	86·6	85·5	87·6
September	87·1	78·5	93·5	86·0	82·6	92·1	87·3	79·6	88·7	84·1	86·1
October	74·0	66·1	78·5	72·3	70·0	80·1	75·0	67·0	79·9	73·4	73·7
November	60·6	58·5	69·9	64·2	58·6	71·2	64·9	53·1	73·5	63·3	63·2
December	57·5	46·7	57·0	51·8	51·5	67·0	59·2	48·1	62·3	55·2	55·9
Year	....	for 1852: 72·4			for 1853: 73·4			for 1854: 73·5			72·9

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
55·1	72·2	89·8	74·3	72·9

RAULPÍNDI.

Latitude North.	Longitude East Green.	Height.
33° 36′·5	72° 59′·8	1,737 feet.

1852-5. CURRIE; JAMESON; BARROW. SR.; $9^h\ 50^m$; 12; $2^h\ 40^m$; 4^h; SS.

1851, Journ. As. Soc. is left out; being calculated by taking the mean of all the observations, it is decidedly too hot, particularly in summer.

Several series being partly contemporaneous, I could take means for the values here presented.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 29.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	49·8	50·4	54·9	52·6	47·9	52·5	50·2	54·6	59·8	57·2	51·4
February	57·1	57·9	62·6	60·2	57·7	58·3	58·0	46·7	54·3	50·5	56·4
March	....	57·9	63·4	60·6	....	....	....	55·2	65·2	60·2	60·4
April	74·2	66·4	74·0	70·2	....	....	....	65·0	83·0	74·0	72·8
May	86·9	75·8	81·4	78·6	73·0	85·5	79·3	72·4	89·6	81·0	81·5
June	90·9	84·8	89·5	87·2	....	....	....	84·6	100·1	92·3	90·1
July	85·5	84·1	90·7	87·4	80·0	90·2	85·1	80·1	92·8	86·4	86·1
August	83·2	80·0	84·8	82·4	80·8	86·0	83·4	78·8	89·8	84·3	83·3
September	85·7	....	....	....	70·7	79·6	75·1	75·3	89·1	82·2	81·0
October	76·2	69·7	81·8	75·8	....	....	....	....	....	....	76·0
November	....	63·1	75·1	69·1	....	....	....	48·9	67·5	58·2	63·1
December	....	53·2	58·9	56·1	....	....	....	....	....	....	54·3
Year	....			....			....			....	71·4

Isolated months (means included). 1855: Jan. 47·2; Nov. 61·9. Dec. 58·7.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
54·0	71·6	86·5	73·4	71·4

SHÁHPUR.

Latitude North.	Longitude East Green.	Height.
32° 14′·0	72° 32′·5	681 feet.

1854 and 1855. Approximations sent in by a native doctor of the 21st. Reg. N. I. They are said to be based on daily extremes.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 32.

The month of January is from 1855.

1854. Mean of the month.			
January	53	July	91
February	54	August	93
March	62	September	87
April	80	October	76
May	86	November	65
June	95	December	58
		Year	75

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
55	76	93	76	75

Sialkót, in the Pănjáb.

Latitude North.	Longitude East Green.	Height.
32° 29′	74° 30′	900 feet.

1852-4. SR.; 4; SS. Toke; Clark.

Schlagintweit, "Met. Mscr.," Vol. 38.

1859. Min. and Max. Parl. San. Rep., Vol. II., p. 170. But the daily range being smaller, nearly throughout between the extremes, than between my other series of SR. and 4, the instruments probably had not been put up in a quite open position. I left out this series.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	40·5	61·8	51·1	41·7	55·2	48·4	41·0	58·1	49·5	49·7
February	51·7	66·1	58·5	49·0	69·2	59·1	44·0	57·0	50·5	56·2
March	56·7	77·6	67·2	57·1	79·2	68·1	52·2	68·8	60·5	65·3
April	65·3	83·0	79·1	65·1	88·3	76·7	61·0	82·1	71·5	75·7
May	73·0	92·1	82·5	72·0	92·1	82	70·2	91·4	80·8	81·8
June	84·0	96·9	90·5	84·0	101·0	92·5	87·1	101·2	94·1	92·3
July	77·4	91·5	84·4	82·1	92·4	87·2	81·2	92·1	86·6	86·0
August	79·0	85·6	82·3	82·0	97·8	89·9	80·2	90·1	85·1	85·8
September	78·2	89·0	83·6	78·0	95·2	86·6	80·1	90·0	85·0	85·0
October	67·1	82·0	74·5	64·5	81·6	73	64·2	79·1	71·6	73
November	57·9	70·0	64	55·0	71·0	63	53·0	69·2	61·1	62·7
December	43·0	61·2	52·1	....	....	....	48·1	58·0	53·0	52·5
Year	for 1852: 72·5					....	for 1854: 71·1			....

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
52·8	74·3	88·0	73·5	72·1

VAZIRABÁD.

Latitude North.	Longitude East Green.	Height.
32° 26′·3	74° 6′·4♉	Ab. 900 feet.

1851. Journ. As. Soc., 1852, Aug. and Oct. in original.

1852-4. INGLIS, EMDON, RUSSEL, SILVER, READ. Means of several series. SR.; 9^h 50^m; 12; 2^h 40^m; 4^h; SS.; and SR.; 10; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 29.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	53·8	46·2	64·2	55·2	45·6	57·6	51·6	40·0	55·0	47·5	52·0
February	61·9	53·2	76·3	64·7	50·8	67·6	59·2	....	....	....	61·9
March	68·5	51·4	75·7	63·5	65·6	81·4	73·5	60·3	71·1	65·7	67·8
April	81·8	67·7	82·2	74·9	71·2	82·0	76·6	....	....	....	77·8
May	91·1	76·8	91·8	84·3	78·2	89·6	83·9	79	91	85·0	86·1
June	95·5	85·1	100·2	92·6	87·0	98·8	92·9	87·1	97·3	92·2	93·3
July	88·3	86·0	96·0	91·0	83·9	95·3	89·6	84·1	90·8	87·4	89·1
August	87·5	82·0	89·9	85·9	85·6	97·1	91·3	84·1	91·0	87·5	88·0
September . . .	....	80·9	93·2	86·5	81·7	95·6	88·6	83·0	90·5	86·7	87·3
October	78·0	69·3	88·3	78·8	69·9	89·6	79·7	68·5	78·0	74·2	77·7
November	67	57·4	75·8	66·6	56·3	75·9	66·1	58·5	71·4	64·9	66·1
December	61	47·7	61·0	54·3	....	....	....	51·6	60·5	56·05	57·3
Year	....	for 1852: 74·9					....			.....	75·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
57·1	77·2	90·1	77·0	75·4

GROUP V: WESTERN INDIA,

RAJVÁRA, GUJRẮT, KĂCH, SINDH.

Ábu.	Bhūj.	Kărráchi.
Ahmadabád.	Dísa.	Khervára.
Ajmír.	Erinpúra.	Nazirabád.
Barōda.	Haiderabád.	Nímăch.
Beávr.	Jacobabád.	Rajkót.

The lower course of the Indus passes through broad plains, but little undulated; a border of cultivated ground follows the shores of the river, but by far the greater part of the province is occupied by the Thăr of Rajvára, the Indian desert. In reference to the breadth of the group, the hills of Beluchistán form the western border of this region, and the elevated grounds of Ajmír rise to the east of it. The climate is cool in winter, very hot in summer, but the difference is considerably smaller than in the Pănjáb. The littoral provinces, Kăch and Gujrát, to the south, have, notwithstanding their vicinity to the sea, a surprising analogy with the type of continental climate.

In the *cool season*, and even considerably later—from November to April—the NE. and E. winds bring down dust and cold from the Pănjáb to the shores of the Arabian sea; but high up the Indus valley sea-breezes may be observed to alternate with the most violent currents from the north; the breezes are so weak that they might easily be overlooked—the more so as wind-guages at Indian stations are but too often badly kept and rusty—if the nocturnal moisture and the great

quantity of dew did not direct attention to the breezes. Dew is here, for a great part of the year, the substitute for rain. In Kărráchi the cool season does not begin much before December: in March, with the westerly direction of the wind the temperature rapidly rises. Cloudless nights and heavy dews are frequent, but also dust-storms and storms with rain occur: the amount of precipitation is very small. At some distance from the sea the cool season may be expected to begin about a month earlier. At Kărráchi 45° Fahr. was observed, Jan. 22, 1851; at Bhūj General JACOB once had 42° as the minimum. (At Multán, in the Pănjáb, my brother ROBERT had, in Jan. 1857, several times 39°; 33° is the absolute minimum I got communicated by General JACOB.)

From March to May the heat increases considerably; it becomes excessive for the lower parts; occasional thunder-storms, dust-storms, and particularly, even during calm days, a suffocating quantity of the suspended solid matter brought over from the desert by the north-east winds is characteristic for this part of the year. Northerly winds prevail till the setting-in of the monsun. This takes place for Kărráchi and Kăch in the beginning of May, at Naushéra and Såkker about middle of May. Observations of temperatures exceeding 100°, even in well-protected localities, are not at all unfrequent. In tents 108° to 110° may be observed.

The temperature in the hot season is high and a residence in the cantonment of Bhūj during the months of April and May, says Dr. BURNES, is rendered almost intolerable by hurricanes, which envelop the houses in dust and sand, which are even driven into the houses through the joints of the windows. The hot wind in May is sometimes so scorching that its blasts are often not unlike the hot air rising up from low burning jungle: 106 degrees have been observed even on the sea-shore, at Mándvi. But we must not forget that, nevertheless, the *means* of the respective months are still considerably lower than in the hottest parts of the Pănjáb: 107°, such as at Dísa in Gujrát, June 9th, 1853, is about the maximum outside the Rajvára desert. The nights during this period are equally suffocating.

Dust-storms[1] have been observed also in the Arabian sea; a very violent dust-fall with storm was communicated to me by Capt. MACDONALD, of the E. I. C. navy, with whom I went over from Aden to Bombay.

[1] Recently, Febr. 20th and 21st, 1864, even at Rome a dust fell which had been carried over from Africa in a very appreciable quantity. SECCHI, "Les Mondes," March 1864.

The *rainy season*, which might coincide with the setting-in of the monsun, is limited to a very small precipitation. In the delta of the Indus, and along the shore, the quantity of rain is even less than farther up, at Naushéra and Seván; from there to the north it diminishes again. At Mithankót storms with rain are rare altogether: dust is the more frequent, and from August, though the south-west winds continue sometimes till October, no more rain falls. In the latter part of the autumn, in November, small quantities of rain occasionally fall high up along the Indus. The winds are variable but chiefly northerly. Even here rains of some unusual amount are somewhat dreaded, as being unhealthy.

Autumn here is the season which makes one suffer most.

The oppression of the atmosphere about the close of the monsun is excessive; the approach of October is dreaded equally by the native and European population as extremely unhealthy. The Răn, flooded with salt water from May to October, begins then to form a marshy swamp before it becomes dry and incrusted with salt. Also the rivers running into the Răn contain scarcely any water, except in the rainy season. Many of the tanks frequently dry up.

The *higher stations* show a temperature somewhat less intolerable during the hot season, but the decrease of temperature is very small, since, Ábu excepted, the rising of the ground for all of them is very gradual.

The *health* in many parts of upper Sindh suffers very much from miasmatic exhalations. The inundations of the Indus—the drying up of which occupies a considerable portion of the year—may be considered as one of the principal causes. Dr. Kirk [1] observed that in Sindh the exhalations from rocks, chiefly in places where the water contained in the rocks is brackish, can also become a material source of unhealthiness; [2] and, unexpected as it may be, a detailed inquiry into the physical conditions of the country verified the fact stated, that here occasionally the rocks, by remaining moist after the country had dried up, are for some period more unhealthy than the flats along the Indus, the period of drying up being more dangerous in reference to

[1] Medical Topography of Sindh. Calcutta, 1847.

[2] But he declares it to be connected "with the unspent material of volcanic agency (!) contained in the rocks and gradually emanating from them." Ibid., p. 20.

malaria than even that of perfect inundation. From the same reason a dry river bed remains for a long time a dangerous locality; the water below the bottom of the dry bed is then still near enough to fill it with its evaporations. Near Kărráchi the water is 12, even 20 feet, below the ground in the dry season; in the bed of the river Siári only 2 feet, perfectly dry as it may appear.

Also the ravines and valleys of some of the smaller hill ranges, such as the Rajmahál hills, or those of Berár and Málva, might perhaps be alluded to as analogous cases, on account of their malarious character continuing all the hot season, apparently dry as they are; but these, at the same time, are covered with such a luxuriant vegetation that a direct comparison with the provinces near the month of the Indus is scarcely possible.

The *delta of the Indus* and the province of *Kăch* are also considered unhealthy by the natives from other parts of India. The most common diseases among the Indians are fever and rheumatism; cholera, which has been so fatal in the neighbouring provinces, has never made much progress in Kăch; fever is the prevailing disease among Europeans.

The physical character of the country, particularly near Bhūj and Mándvi, would not lead one to expect this; for the general appearance of Kăch is barren; and particularly the district of Kăch proper, in which Bhūj is situated, is the most unproductive of the whole province.

Kăch is surrounded by the Gulf of Kăch and the Arabian sea to the east and south, by the Răn, or salt-moor, to the north; the Kóri river separates it from the delta of the Indus to the west: water, however, is scarce and often brackish, and the land, but little cultivated, insufficient for its population on account of its excessive barrenness; for 9 months of the year scarcely a blade of vegetation is visible. The drying up of the Răn over a surface exceeding in extent 6000 square miles cannot be accomplished without materially affecting the atmosphere of the neighbouring provinces even over a considerable distance.

The *absolute extremes* I compiled from Dr. HANBURY's observations at Dísa.

The *mean insolation* I added for Nímăch and Dísa from my manuscripts; and for Kărráchi from the tables of Dr. COLES in the Parl. Rep., Vol. II., p. 807. The insolation in Dísa is greatest, in consequence of the sky being on an average less clouded, the air, however, very steamy.

Absolute Extremes,

from observations at Dísa, 1857 to 1859.

Months.	Extremes.		Months.	Extremes.	
	Min.	Max.		Min.	Max.
January	26	75	July	77	103
February	33	81	August	76	98
March	41	82	September	66	101
April	51	100	October	53	99
May	59	105	November	33	89
June	64	107	December	29	70

Mean Insolation,

from Observations at Nímăch, 1852-1853; at Dísa, 1857 to 1859; and at Kărráchi, 1856 to 1860.

Months.	Nímăch.	Dísa.	Kărráchi.	Months.	Nímăch.	Dísa.	Kărráchi.
January	93	104	91	July	88	120	98
February	108	109	96	August	90	106	95
March	112	118	102	September	98	114	99
April	111	126	103	October	106	122	106
May	109	127	102	November	100	115	106
June	102	122	107	December	93	108	94

For the general character of the southern points of the Duabs and of many parts of the Thăr, or Indian desert, the views from the Sindh—Sắger—Duáb, quoted in the preceding group may also be referred to here.

Ábu, in Rajvára.

Latitude North.	Longitude East Green.	Height.
24° 45′	72° 46′	3,850 feet.

A. 1851 and 1852, Means of isolated months. Communicated by Manestry.
Schlagintweit, "Met. Mscr.," Vol. 39.

Mean of the months, series *A*.

March 1852	74	May 1851	80	June 1851	77
		„ 1852	76	„ 1852	79
April 1851	75½	Mean	78	Mean	78
1852	78				
Mean	76·7			July 1851	74

B. A complete series of the 12 months is communicated in Macpherson's Madras Sanitaria Reports, 1862, p. 21; the year is not mentioned.

Mean of the months, series *B*.

January	61	April	77	July	69	October	69
February	61	May	77	August	69	November	69
March	69	June	77	September	69	December	71

General mean of the months.

January	61	April	76·8	July	71·5	October	69
February	61	May	77·5	August	69	November	69
March	71·5	June	77·5	September	69	December	71

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·3	75·3	72·7	69·0	70·3

Ahmadabád, in Gujrât.

Latitude North.	Longitude East Green.	Height.
23° 0′	76° 33′	320 feet.

1858 and 1859. Thompson. Mean of extremes. Parl. San. Rep., Vol. II., p. 717.

1858 and 1859.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	65	78	71	July	77	104	90
February	65	96	80	August	77	92	84
March	73	94	83	September	77	90	83
April	82	104	93	October	77	90	83
May	86	108	97	November	70	87	78
June	84	94	89	December	60	79	69

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
73·3	91·0	87·7	81·1	83·3

Ajmír, in Rajvára.

Latitude North.	Longitude East Green.	Height.
26° 27′·2	74°.40′·6	Ab. 1,500 feet.

1852-4. Lord; Sanderson; Ewart. SR.; $9^h\ 50^m$; N.; $2^h\ 40^m$; 4^h; SS.—SR.; 10; 4; 10.

Schlagintweit, "Met. Mscr.," Vol. 33.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	....	....	55·1	57·1	56·1	64·1	70·5	67·3	61·7
February	....	....	....	68·4	73·9	71·1	63·8	71·4	67·6	69·3
March	....	....	....	76·9	83·7	80·3	75·7	76·9	76·3	78·3
April	....	....	....	82 6	89·9	86·2	87·3	90·2	88·7	87·4
May	....	....	....	88·3	96·6	92·4	93·2	99·4	96·3	94·3
June	90·0	95·5	92·7	88·2	95·4	91·8	93·2	92·8	93·0	92·5
July	82·7	88·3	85·5	....	....	....	85·0	86·4	85·7	85·6
August	78·0	80·5	79·2	83·7	89·0	86·3	81·7	83·6	82·6	82·7
September	78·9	83·8	81·3	83·1	89·2	86·1	82·4	83·8	83·1	83·5
October	77·7	84·6	81·1	80·5	86·4	83·4	....	....	....	82·2
November	72·1	75·0	73·5	73·7	78·8	76·2	68·9	69·8	69·3	73·0
December	....	....	....	64·3	69·9	67·1	62·5	63·7	63·1	65·1
Year			....			....			....	79·6

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·3	86·6	86·9	79·5	79·6

Baróda, in Gujrât.

Latitude North.	Longitude East Green.	Height.
22° 16′	73° 14′	L. a. L. S.

A. 1854 and 1855. Dr. von Liebig. 1854, 6; 10; 4; 10. His manuscripts also contain many periods of more frequent observations. 1855, hourly from 6^h A.M. to 9^h P.M. Particularly careful.

Schlagintweit, "Met. Mscr.," Vol. 33.

B. 1847 to 1853. Means in the Parl. San. Rep., Vol. II., p. 724. As I do not know the details, I only add them for comparison. April and July are the only months showing an appreciable difference; the mean of the year is but 0·4° Fahr. warmer.

A. 1854

Months.	6^h A.M.	4^h P.M.	Mean.	Months.	6^h A.M.	4^h P.M.	Mean.
January	....	....	....	July	78·4	83·3	80·8
February	59·9	84·5	72·2	August	77·9	85·0	81·4
March	69·1	94·3	81·7	September	78·1	86·2	82·1
April	78·5	102·7	90·6	October	72·8	86·9	79·8
May	84·0	105·5	94·7	November	64·4	82·2	73·3
June	82·2	94·6	88·4	December	61·6	80·8	71·2
1855							
January	56·2	82·4	69·3	February	60·8	87·8	74·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
71·2	89·0	83·5	78·4	80·5

B. Means for 1847 to 1853.

January	71	April	81	July	85	October	80
February	70	May	94	August	84	November	77
March	83	June	89	September	83	December	73

Beávr, in Rajvára.

Latitude North.	Longitude East Green.	Height.
26° 6′	74° 21′	Ab. 2000 feet.

1854. Small. Only means for isolated months deduced from extremes.
Schlagintweit, "Met. Mscr.," Vol. 33.

1854. Means.					
January	.....	May	94·5	September	82·6
February	64·75	June	91·7	October	....
March	75·1	July	85·8	November	68·9
April	88·2	August	82·6	December	....

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
....	85·9	86·7	....	...

Bhūj, in Kăch.

Latitude North.	Longitude East Green.	Height.
23° 17′	69° 40′	281 feet.

1852 and 1853. Incomplete. Means communicated by Manestry. Schlagintweit, "Met. Mscr.," Vol. 39.
Sept.—Nov. are estimated from analogy with Kärráchi, for the mean of the year.

1852. Mean of the month.						1853		Mean.
January	65	May	84	September	(79)	January	66	65½
February	72	June	87	October	(75)	February	71	71½
March	80	July	81	November	(70)	March	79	79½
April	82	August	80	December	59			

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·3	81·8	82·7	74·7	76·1

Dísa, in Gujrât.

Latitude North.	Longitude East Green.	Height.
24° 14′	72° 3′	400 feet.

1857-9. Capt. Maunsell. Means of the observations taken at the government observatory are contained in Parl. San. Rep., Vol. II., p. 767; but the mean of the dry bulb is evidently taken from a combination of hours not corresponding to the true mean. I preferred deducing it from the extremes; but I add the other values for comparison.

A. 1857 to 1859.

Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	49·6	79·1	64·3	July	78·6	93·2	85·9
February	53·9	85·4	69·6	August	75·5	87·1	81·3
March	61·5	94·1	77·8	September	73·3	88·5	80·9
April	70·5	101·5	86·0	October	62·4	92·7	77·5
May	77·7	105·6	91·6	November	53·4	89·1	71·2
June	78·7	100·2	89·4	December	48·0	82·4	65·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·3	85·1	85·5	76·5	78·3

B. 1857 to 1859 "Means" unreduced.

January . . .	67·6	April . . .	91·8	July	85·4	October	83·5
February . . .	74·6	May . . .	92·5	August	81·1	November . . .	80·4
March	84·5	June . . .	89·9	September . .	81·9	December . . .	70·6

ERINPÚRA, in Rajvára.

Latitude North.	Longitude East Green.	Height.
25° 9′·3	73° 6′·3 ♁	Ab. 1500 feet.

1850-4. BOWHILL. SR.; 10; N.; 4; SS.; 10. SCHLAGINTWEIT, "Met. Mscr.," Vol. 33.

(Dec. 1852 was interpolated to obtain the means.)

Months.	1850			1852			1853			1854			General mean.
	SR.	$2^h\,40^m$	Mean of the month.	SR.	Noon.	Mean of the month.	SR.	Noon.	Mean of the month.	SR.	Noon.	Mean of the month.	
Jan.	....	....	....	....	....	....	38·2	58·8	48·5	....	....	....	48½
Febr.	....	....	....	....	....	....	49·4	68·6	59·0	....	....	....	(59)
March	....	....	....	64·5	79·5	72·0	58·9	79·4	69·1	....	....	....	70·5
April	....	....	....	69·2	87·2	78·2	83·5	92·5	88·0	74·8	97·5	86·1	84·1
May	....	....	...	84·6	92·0	88·4	81·7	92·1	86·9	79·8	106·3	93·0	89·4
June	....	....	....	84·0	93·5	88·7	83·1	94·9	89·0	82·0	104·3	93·1	90·3
July	....	....	....	79·2	88·7	83·9	78·0	86·5	82·2	78·6	99·4	89·0	85·0
Aug.	79·8	84·2	82·0	75·6	82·5	79·0	78·5	86·5	82·5	75·7	94·5	85·1	82·1
Sept.	79·2	85·4	82·4	76·1	82·6	79·3	78·7	88·7	83·7	74·1	88·7	81·4	81·7
Oct.	73·8	91·2	82·5	64·3	81·1	72·7	74·5	90·0	82·2	....	....	....	79·1
Nov.	....	....	....	57·5	77·0	67·2	....	....	....	....	....	....	(67·2)
Dec.	....	....	....	....	....	(56)	....	....	....	....	....	....	(56)
Year			....			....			....			....	74·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
54·5	81·3	85·8	76·0.	74·4

Haiderabád, in Sindh.

Latitude North.	Longitude East Green.	Height.
25° 22′	68° 25′	99 feet.

1856 and 1857. Asher. Means, not detailed. Parl. San. Rep., Vol. II., p. 798.

1856 and 1857.							
January	64·2	April	86·5	July	90·6	October	82·4
February	71·2	May	91·0	August	88·0	November	72·5
March	80·7	June	92·2	September	85·0	December	65·5

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·0	86·1	90·3	80·0	80·8

Jacobabád, in Sindh.

Latitude North.	Longitude East Green.	Height.
25°	69°	220 feet.

1848 to 1859, the year 1857 being omitted. Major Merewether. Means not detailed, the high temperature in summer is caused by its situation in a flat sandy dry desert, with very little rain. Parl. San. Rep., Vol. II., p. 859.

1848 to 1856, 1858 and 1859.							
January	60	April	85	July	97½	October	80
February	65	May	95	August	92½	November	70
March	74	June	99	September	91	December	62½

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·5	84·7	96·3	80	80·0

KĂRRÁCHI, in Sindh.

Latitude North.	Longitude East Green.	Height.
24° 45′·5	67° 0′·9	L. a. L. S.

1847. Communicated by Col. SYKES. Phil. Trans., 1850, p. 361. Mean of daily extremes.

1860. Recently a set of very good instruments has been sent out, but the details have not reached me; the means in the Parl. San. Rep. are not defined as to the combination of the hours used.

1847.			
January	67	July	84
February	67	August	88
March	77	September	86
April	79	October	80
May	83	November	72
June	87	December	63

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66	80	86	79	77·7

KHERVÁRA, in Rajvára.

Latitude North.	Longitude East Green.	Height.
26° 4′	74° 20′	Ab. 1,200 feet.

1852-4. Observer's name illegible (Surgeon of the Mevár Bhil corps). SR.; 10; 4; SS.; then SR.; 10; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 33.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	....	....	49·1	64·7	56·9	51·5	77·1	64·3	60·6
February	....	....	....	58·3	78·0	68·1	57·6	80·6	69·1	68·6
March	....	....	....	68·5	89·5	79·0	66·7	91·3	79·0	79·0
April	78·0	94·1	86·0	77·5	94·3	85·9	78·1	102·7	90·4	87·4
May	81·1	95·8	88·4	82·3	100·1	91·2	83·9	107·5	95·7	91·8
June	81·3	91·5	86·4	81·4	92·7	87·0	80·4	97·5	88·9	87·4
July	77·4	85·5	81·4	74·7	80·5	77·6	78·3	85·9	82·1	80·4
August	75·1	82·1	78·6	73·9	83·9	78·9	76·0	82·5	79·2	78·9
September	74·8	83·4	79·1	73·4	81·8	77·6	76·2	89·0	82·1	79·6
October	68·7	85·0	76·8	67·4	88·1	77·7	....	....	....	77·2
November	61·3	79·5	70·4	60·3	82·1	71·2	61·3	79·0	70·1	70·6
December	52·8	68·1	60·4	50·2	74·5	62·3	....	....	....	61·3
Mean of the year			....	for 1853: 76·1					....	76·9

General means of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
63·5	86·1	82·2	75·6	76·9

NAZIRABÁD, in Rajvára.

Latitude North.	Longitude East Green.	Height.
26° 18′	74° 42′	1,487 feet.

1832-5. OLIVER. Journ. As. Soc., IV., p. 50. SR.; $2\frac{1}{2}$. In the means I communicated in the Trans. of the Royal Soc., this series only could be given; the series 1859-60 I did not obtain till Aug. 1863.

Aug. 1859 to July 1860. DURHAM. Extremes and Mean. Parl. San. Rep., Vol. II., p. 756.

Months.	1832-35.	1859-60.			General mean.
	Means.	Min.	Max.	Mean.	
January	59·2	61·0	65·0	63·0	61·1
February	62·7	59·0	76·0	67·5	65·1
March	71·8	73·0	80·0	76·5	74·1
April	82·6	83·0	91·0	87·0	84·8
May	90·4	84·0	95·0	89·5	90·0
June	90·1	88·0	99·0	93·5	91·8
July	85·7	84·0	91·0	87·5	86·6
August	82·7	77·0	89·0	77·5	80·1
September	82·5	76·0	86·0	81·0	81·7
October	78·8	78·0	84·0	79·0	78·9
November	68·5	66·0	84·0	75·0	71·7
December	58·2	59·0	69·0	64·0	61·1

General mean of the seasons and of the year.

	Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
1832-5	60·0	81·6	86·2	76·6	76·1
1859-60	64·8	84·3	86·2	78·3	78·4
Mean	62·4	83·0	86·2	77·5	77·2

Nímăch, in Rajvára.

Latitude North.	Longitude East Green.	Height.
24° 27′·5	74° 59′·05	1,356 feet.

1851. Journ. As. Soc., 1852.
1852 and 1853. Mackensie. SR.; 10; 4; SS. } Schlagintweit, "Met. Mscr.," Vol. 33.
1854 and 1855. G. von Liebig. SR.; 10; 4; 10. }

Months.	1851	1852			1853			1854			1855			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	65·5	....	....	....	57·0	69·1	63·0	63·4	73·2	68·3	51·2	66·7	58·9	63·9
Febr.	73·5	....	....	....	68·1	80·1	74·1	57·6	72·4	65·0	62·9	78·7	70·8	70·8
March	81·5	....	....	....	74·1	88·2	81·1	66·2	86·5	76·3	68·2	82·8	75·5	78·6
April	88·5	....	....	....	80·2	92·2	86·2	77·3	97·5	87·4	74·5	96·0	85·2	86·8
May	90	81·2	94·2	87·7	84·2	97·2	90·7	81·7	101·1	91·4	83·2	99·8	91·5	90·3
June	86	81·2	90·3	85·7	83·3	90·3	86·8	83·2	90·7	86·9	80·3	94·5	87·4	86·6
July	....	78·2	85·2	81·7	75·2	79·2	77·2	78·7	81·7	80·2	76·9	81·0	78·9	79·5
Aug.	....	75·2	80·2	77·7	76·2	81·2	78·7	76·9	79·4	78·1	75·3	80·6	77·9	78·1
Sept.	....	76·9	83·2	80·0	77·2	80·2	78·7	76·0	77·6	76·8	....	....	....	78·5
Oct.	....	77·2	87·2	82·2	75·2	81·1	78·1	73·4	78·3	75·8	....	....	....	78·7
Nov.	....	71·1	83·2	77·1	70·1	76·1	73·1	67·5	72·9	70·2	....	....	....	73·5
Dec.	....	....	....	....	61·0	68·1	64·5	61·5	70·6	66·0	....	....	....	65·2
Year	....			....	for 1853: 77·7			for 1854: 76·9					....	77·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·6	85·2	81·4	76·9	77·5

RAJKŐT, in the peninsula of Kattivár, Gujrăt.

Latitude North.	Longitude East Green.	Height.
22° 18′	70° 47′	450 feet.

Jan. 1857 to May 1860. JOYNT. The observations were made at SR.; 10; 4; 10; though no details are communicated. The values called "Min. and Max." in the Parliamentary Report are supposed to be SR. and 4^h P.M., of which I preferred taking the mean to introducing the result of the four observations, which is too warm. Parl. San. Rep., p. 370.

1857 to 1860.							
Months.	SR.	4^h P.M.	Mean.	Months.	SR.	4^h P.M.	Mean.
January	58·7	77·7	68·2	July	81·4	88·3	84·8
February	61·8	82·5	72·1	August	79·2	84·0	81·6
March	70·7	89·2	79·9	September	78·0	84·6	81·3
April	77·2	96·5	86·8	October	77·1	88·6	82·8
May	82·5	99·1	90·8	November	65·8	86·1	75·9
June	83·0	95·0	89·0	December	63·9	79·1	71·5

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
70·6	85·8	85·1	80·0	80·4

GROUP VI: CENTRAL INDIA,

BERÁR, ORÍSSA, MÁLVA, BĂNDELKHÁND.

Báitul.	Kokonáda.	Orái.
Chikáldah.	Maghanássi Hill.	Púri.
Gálli Parvátum.	Máhu (Mhow).	Săgar.
Hamírpur.	Màthúr Hill.	Samulkóttah.
Hushangabád.	Nágpur.	Sehór.
Jáblpur	Nărsínghpur.	Sisabáldi.
Jhánsi.	Naugóng.	Vizagapatám.

The territories comprising Băndelkhănd, Málva, and Berár, are limited to the north by the valley of the Ganges and Jámna, to the east by Bahár and Oríssa, to the south by the Dékhan, and to the west by the hilly ranges of Rajvára. Though in many parts the elevation is not inconsiderable, its influence upon the depression of temperature is limited by the gradual and general rising of the ground; and the position of these provinces in the most central part of India equally contributes to compensate the cooling effect of their elevation.

The meteorological registers are chiefly those kept by the medical officers; for describing the climate my brothers Adolphe and Robert, who crossed these regions on different routes in 1855-6, also brought me, besides their own observations, much valuable information from the residents, amongst whom I have to name Major Scott, Quarter-master-general at Madras for Jáblpur, and Mr. Higgins for

Ságer. Also Dr. FORD's "Meteorological Journal," kept with truly scientific detail at Nărsínghpur, must be mentioned as very valuable.[1]

Hilly regions of comparatively little elevation differ much more from the temperature of the plains in winter than in summer. The greater *surface* of solid matter they present increases as well the loss of heat by radiation in the cool season, as it increases the effect of insolation during the hot season. Besides, the lower parts of such mountainous regions have their temperature additionally depressed by the circumstance that descending currents produce a sensible accumulation of cold air in the deeper grounds.

The *cool season* in Central India, is indeed remarkably fresh; it has variable winds and variable weather. Northerly winds, however, prevail. At the higher stations from December to February the nights are cold.

From March to June, including the *hot season*, the north-westerly winds are the predominating ones. But storms and occasional rains with south-west winds may occur. In March the mornings and evenings are still pretty cool, but in April, when unsettled weather becomes more frequent, it often happens that for a succession of two or three days the weather continues most gloomy and oppressive. In May and in the early part of June the heat reaches its maximum; dust-storms, also thunder-storms with a little rain, are observed already in May. The proper *rainy season*, with the south-west monsun, sets in only about the end of June, and can be considered as nearly over about the last week of August.

In *autumn* north-west winds begin again to predominate in September; short but heavy rains may occur, but generally the sky continues to remain clear and nearly cloudless for weeks. In Dr. CLARKE's registers I found noted fifteen succeeding days "without any cloud." Also October and November continue clear and pleasant. The wind then becomes more easterly.

The Chámbal valley, south-west of Gválior, partakes still of this climate, but the western border of its river-system, represented in the tables by the stations of Biúr and Ajmír, has a climate considerably modified by the Rajvára desert. Also the quantity of rain is much reduced and variable in the different years, though the monsun sets in about the beginning of May.

[1] Amongst details recently published, chiefly in reference to cultivation and settlement, I quote "Calcutta Review," 72. and Capt. PEARSON's very interesting Report on the Saugur and Nerbudda districts, "Indian Mail," April 15, 1862.

In reference to *healthiness* it must be added that marshes and jhils are excluded by the form of country. The numerous jángels, however, which are frequently so malarious, that they can scarcely be inhabited by the half-savage aboriginal tribes, would exercise a much more unfavourable influence on some of the stations, were not the small quantity of rain a very effective protection. The rapid changes which sometimes happen in the cool season frequently become the cause of acute rheumatic complaints, particularly amongst the natives.

The *absolute Extremes* I collected from two different stations, in order to keep account of the great variety of elevation at these stations; for Hamírpur they are selected from Dr. CLARKE's observations, April 1851 to September 1852; the period for the maxima and minima for Nărsínghpur, observed by Dr. FORD, is nearly contemporaneous with that at Hamírpur; beginning in July 1851, ending with October 1852. He also had exposed thermometers put up in a parabolic reflector: they differed 4 to 5 degrees from one in the ordinary position. In January he obtained as the means 39·8 and in the reflector 35·3; the absolute minima were 31·5 and 25·5° Fahr.

The *Mean Insolation* I took from Jhánsi; its low elevation allows one to recognise the full effect of the latitude of these regions.

For Nărsínghpur an observation with a black bulb thermometer will be given later, together with my experimental observations of various thermometers exposed simultaneously.

Absolute Extremes.

Hamírpur, 645 feet.			Nărsínghpur, 1,305 feet.		
Months.	Extremes.		Months.	Extremes.	
	Min.	Max.		Min.	Max.
January	47	81	January	39	84
February	51	87	February	48	92
March	62	91	March	58	96
April	64	109	April	65	102
May	71	116	May	74	104
June	71	116	June	77	106
July	73	105	July	73	99
August	75	95	August	73	91
September . . .	77	99	September . . .	67	91
October	71	94	October	60	92
November	52	84	November	60	79
December	47	76	December	47	75

Mean Insolation.

Jhánsi, 745 feet.			
January	81	July	108
February	94	August	104
March	92	September. . . .	107
April	118	October	106
May	121	November	99
June	121	December	82

No views of these provinces have as yet been published in the Atlas.

BÁITUL, in Berár.

Latitude North.	Longitude East Green.	Height.
21° 51′·2	77° 54′·8	Ab. 2,000 feet.

1851. Journ. As. Soc.

1851-4. R. F. THORNTON; CHISHOLM. SR.; 9^h 50^m; 10; N.; 2^h 40^m; 4; SS.; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 27.

(1851, Journal Asiatic Soc. is excluded: it seems to give only the afternoon temperature.)

Months	1851			1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	....	....	....	39·1	72	55·5	58·5	67·2	62·8	45·7	73·8	59·7	59·3
Febr.	....	....	....	48	76	62·0	61·4	74·5	67·9	45·3	68·8	57·0	62·3
March	....	....	....	60	85·7	72·8	73	84½	78·7	54·9	75·3	65·1	72·2
April	....	....	....	68·1	96·9	82·5	77·2	90·5	83·8	....	....	....	83·1
May	....	....	....	68·2	95·2	81·7	84·5	94·5	89·5	75·7	91·0	83·3	84·8
June	....	....	....	68·5	85·4	76·9	80·2	87·0	83·6	76·1	85·5	80·8	80·4
July	77·8	80·1	78·9	....	....	....	73	78	75·5	74·0	77·8	75·9	76·8
Aug.	76·4	78·8	77·6	70·1	80·2	75·1	71·2	79·5	75·3	70·9	78·2	74·5	75·6
Sept.	73·0	75·0	74·0	72·2	82·3	77·2	70	80·2	85·1	72·6	81·5	77·0	78·3
Oct.	69·7	82·0	75·8	69	83·1	76·0	61	78·2	69·6	....	....	....	73·8
Nov.	....	....	....	....	....	....	52	77	64·5	56·7	67·7	62·2	63·3
Dec.	....	....	....	58·7	66·2	62·4	....	....	....	48·9	69·6	59·2	60·8
Year			....			....			....			....	72·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
60·8	80·0	77·6	71·8	72·5

CHIKÁLDAH, on the Víndhya range, Berár.

Latitude North.	Longitude East Green.	Height.
20° 50′	77° 25′	Ab. 3,600 feet.

MACPHERSON, Madras Sanitaria Reports, 1862, p. 21 and 58. Year and time of observation not indicated. This station has been used as a sanitarium for officers in the Dékhan and the Nizám's country.

Mean of the months.

January .	60	April . . .	83	July . . .	. .	October	. .
February.	60	May . . .	83	August . .	. .	November	71
March . .	70	June . . .	71	September	. .	December	71

Mean of the seasons.[1]

Dec. to Febr.	March to May.
63·7	78·7

GÁLLI PARVÁTUM, north of Vizagapatám, in Oríssa.

Latitude North.	Longitude East Green.	Height.
18° 30′	82° 50′	4,988 feet.

A hilly range visited in 1859 by Dr. MACPHERSON and a party of military and medical officers for the purpose of exploration with respect to the possibility of erecting a sanitarium. Madrás Sanitaria Reports, 1863, p. 41 to 47. The highest point, Gállikondah, has an elevation of 5,346 feet; the height given above refers to the encamping ground. A previous visit had been made in 1854, April 21 to May 20.

Approximate means.

February 18 to 22	66	April 21 to May 20	78

As corresponding means from Vizianágram I add

1859, February 18 to 22		80·1
1854, May . . .	1 to 31	87·1.

[1] The first data of Dr. MACPHERSON (also contained in my Meteorological Table, No. 1) were for Dec. to Febr.: 59; for March to May 81; mean of the year about 70.

HAMÍRPUR, in Băndelkhănd.

Latitude North. 25° 58′ Longitude East Green. 80° 12′ Height. 645 feet.

1851 and 1852. STEWART; CLARKE. SR.; 10; 4; 10; Min.;—contains also a very good account of the correction of the instruments, and many valuable details about humidity. SCHLAGINTWEIT, "Met. Mscr.," Vol. 27.

Months.	1851			1852			General mean.	Months.	1851			1852			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.			SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	....	.....	....	59·0	70·4	64·7	(64·7)	July	83·4	89·6	86·5	81·3	86·9	84·1	85·3
Febr.	....	.....	....	67·0	81·5	74·2	(74·2)	Aug.	82·5	89·5	86·0	82·3	88·7	85·5	85·7
March	....	.....	....	68·9	84·5	76·7	(76·7)	Sept.	80·8	89·0	84·9	82·2	88·0	85·1	85·0
April	80·4	97·6	89·0	75·2	97·3	86·2	87·6	Oct.	77·8	86·4	82·1	....	....	....	(82·1)
May	87·7	103·1	95·4	83·0	101·5	92·2	93·8	Nov.	62·0	76·0	69·0	....	....	....	(69·0)
June	88·5	98·8	93·6	86·2	100·3	93·2	93·4	Dec.	56·0	71·5	63·7	....	....	....	(63·7)
								Year			....			....	80·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·5	86·0	88·1	78·7	80·1

HUSHANGABÁD, in Málva.

Latitude North. 22° 45′ Longitude East Green. 77° 42′ Height. 1050 feet.

1851. Isolated months, Journ. As. Soc., 1852.
1854. WILSON. SR.; 10; 4; 10. SCHLAGINTWEIT, "Met. Mscr.," Vol. 27.

Months.	1851	1854			General mean.	Months.	1851	1854			General mean.
	Mean.	SR.	4h P.M.	Mean.			Mean.	SR.	4h P.M.	Mean.	
March	79	77·3	85·2	81·2	80·1	July	85	81·9	83·9	82·9	83·9
April	90	....	....	....	(90)	Aug.	82	80·4	82·3	81·3	81·6
May	94	91·4	99·6	95·5	94·7	Sept.	81	79·7	81·8	80·7	80·8
June	90	89·0	93·2	91·1	90·5	Oct.	80	....	....	....	(80)
						Nov.	70	69·8	73·3	71·5	70·7

Mean of the seasons.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
....	88·3	85·3	77·2	....

Jáblpur, in Málva.

Latitude North.	Longitude East Green.	Height.
23° 9′·7	79° 56′·3	1,396 feet.

1823-29. Spilsbury, Gleanings of Sc., III., p. 288.

1851-55. Cheyne; Wilkinson; Butler; Crozier. SR.; $9^h\ 50^m$; 10; N.; $2^h\ 40^m$; 4; SS. Schlagintweit, "Met. Mscr.," Vol. 27.

Months.	1823	1825	1828	1829	1851			1852			1853			1854			Genral mean.
	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	....	....	61 3/4	62 3/4	..	..	....	....	....	....	57·7	67·0	62·35	55	74	64·5	62·8
Febr.	....	64 1/2	64 1/2	63 3/4	..	..	....	57	81	69·0	60	78	69·0	62	78	70·0	66 8
March	74	71	76 1/2	74	..	..	....	68	84	76·0	69	85	77·0	69·8	83·4	76·6	75·0
April	86 1/4	88 1/4	86 1/4	84	..	..	....	75	95	85·0	73	91	82·0	....	....	....	85·3
May	88 1/2	92 1/4	90	93 1/4	..	..	....	81	96	88·5	83	99	91·0	86·4	104·7	95·55	91·3
June	88 1/2	88 3/4	88	85 3/4	..	..	....	81	91	86·0	84	92	88·0	85·3	94·6	89·95	87·8
July	81	81 1/2	82 1/4	78 3/4	78	83	80·5	81·8	83·7	82·75	77	79	78·0	80·6	86·0	83·3	81·0
Aug.	78 1/2	82 1/2	79 3/4	79 3/4	77	84	80·5	77·8	82·3	80·05	77	84	80·5	78·9	84·6	81·75	80·4
Sept.	77 3/4	78 3/4	90 1/4	80 1/2	74	83	78·5	77	82	84·5	80	82	81·0	77·6	83·8	80·7	81·5
Oct.	72 3/4	74	74 1/4	74 3/4	69	84	76·5	74	83	78·5	69	81	75·0	....	....	....	75·1
Nov.	67 1/2	70	66 3/4	66 1/2	..	..	....	61	76	68·5	..	..	....	62·2	74·1	68·15	67·9
Dec.	60 3/4	55 3/4	61 3/4	61	..	..	....	52	68	60·0	..	..	....	59·2	71·5	65·35	60·8
Year	....	....	76·8	75·4			....			....			....			....	76·3

Isolated month (mean). 1855: Jan. 62 5.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
63·5	83·9	83·1	74·8	76·3

JHÁNSI, in Băndelkhånd.

Latitude North.	Longitude East Green.	Height.
25° 28′	78° 35′	745 feet.

1851 and 1852. ALLEN; HENDERSON. SR.; 10; 4; SS. The months with means only are from As. Journ., 1852; of these no details are known.

Months.	1851			1852			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	....	....	....	51·5	75·7	63·6	63·6
February	....	....	....	58·5	82·6	70·5	70·5
March	....	....	80·8	69·9	84·1	77·0	78·9
April	....	....	88·6	78·1	98·4	88·2	88·4
May	....	....	96·2	83·9	98·6	91·2	93·7
June	....	....	94·4	86·3	95·3	90·8	92·6
July	82·5	87·6	85·0	80·6	85·8	83·2	84·1
August	81·0	85·4	83·2	79·7	83·7	81·7	82·4
September	76·6	86·0	81·3	80·4	86·1	83·2	82·2
October	73·7	86·5	80·1	73·9	88·9	81·4	80·7
November	....	....	73·6	66·3	80·4	73·3	73·4
December	....	....	65·7	57·1	70·3	63·7	64·7
Year			....	for 1852: 79·0			79·6

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
66·3	87·0	86·4	78·8	79·6

KOKONÁDA, in Oríssa.

Latitude North.	Longitude East Green.	Height.
17° 6′	82° 14′	L. a. L. S.

1850-53. FOWLE; FARLEY; THOMPSON. SCHLAGINTWEIT, "Met. Mscr.," Vol. 9.

Only approximate means; the hours of observation appear not to have been kept very regularly, but the means seem to be accurate enough since the daily variation is very small.

1851-53, Means of the month.							
January	74·5	April	85·1	July	83·3	October	79·0
February	77·9	May	87·8	August	82·3	November	77·3
March	81·0	June	86·3	September	82·0	December	75·4

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·9	84·6	84·0	79·4	81·0

MAGHANÁSSI HILL, in Oríssa.

Latitude North.	Longitude East Green.	Height.
21° 38′	86° 24′	3,820 feet.

1859, April. KENDALL. Approximated mean by extremes; Selection of Bengal Rec., XXXVI., 1861, p. 34. The values have been obtained by self-registering instruments from April 6 to 22—a period which for general comparison also may be considered as nearly equal in temperature to the mean of the hot season—March, April, May.

	Min.	Max.	Mean.
1859, April	65·5	82·3	73·9

Máhu (Mhow), in Málva.

Latitude North.	Longitude East Green.	Height.
22° 33′	75° 49′	1,862 feet.

April 1859 to March 1860. Arnott. The means appear to be deduced from the extremes. Parl. San. Rep., p. 674. Col. Sykes, Phil. Transactions, 1835, p. 182, gives 74° as the approximated mean of the year (for 1828?)

1859 to 1860.							
January	70	April	86	July	82	October	77
February	71	May	87	August	75	November	75
March	80	June	74	September	75	December	71

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
70·6	84·3	77·0	75·6	77·0

Măthúr-Hill, near Kámpti, in Berár.

Latitude North.	Longitude East Green.	Height.
22° 13′	78° 40′	3,400 feet.

1860. Watson. Mean of observations made every three hours in an open hut with thatched roof. Calc. Sanit. Establ., 1861, p. 251-254.

1860, May 10 to 31: 82·9.

For comparing the Kámpti observations, there made in a tent, observations in a tent were also made on the Măthúr-Hill: they showed the decrease to be 11·5° Fahr. for the difference of level of 3,400-99—2400 feet, or of 1° Fahr. for 260 feet.

NÁGPUR, in Berár.

Latitude North.	Longitude East Green.	Height.
21° 10′	79° 7′	935 feet.

1814-17. LLOYD. SR.; 8; 3; SS. Journ. As. Soc., VIII., p. 172. In BALFOUR's Barometrical sections, p. 31, means are given for a "Nagpur," which appears, however, to be altogether a different place. It is not sufficiently defined.

Months.	1814	1815	1816	1817	General mean.
	Mean of the month.				
January	....	71·0	70·6	72·4	71·4
February	....	73·9	75·4	75·3	74·9
March	....	85·2	85·1	82·4	84·3
April	93·0	93·9	92·1	....	93·0
May	98·4	84·0	96·4	....	96·3
June	90·3	85·5	82·3	....	86·0
July	82·5	81·0	79·5	....	81·0
August	82·7	81·4	79·3	....	81·1
September	84·3	80·2	80·0	....	81·5
October	83·1	81·2	80·4	....	81·6
November	75·3	74·8	75·1	....	75·4
December	72·6	74·2	71·2	....	72·6
Year	....	80·5	80·6	....	81·6

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·9	91·2	82·7	79·5	81·6

NĂRSÍNGHPUR, in Málva.

Latitude North. 22° 57′ Longitude East Green. 79° 8′ Height. 1,305 feet.

1820. I found this year in DOVE, Berl. Acad., 1847, p. 102; without any further detail.
1851 and 1852. FORD. SR.; 9^h 50^m; N.; 2^h 40^m; 4^h; SS. SCHLAGINTWEIT, "Met. Mscr.," Vol. 27.
Very careful observations, which contain, besides the thermometrical observations, many valuable remarks and experiments.

1820, Means of the month.

January	61¼	April	82	July	80½	October	78½
February	61¾	May	81½	August	81	November	70½
March	72¼	June	86¼	September	80¾	December	62

Mean of the year: 74·8.

1851.

Months.	SR.	4^h P.M.	Mean of the month.	Months.	SR.	4^h P.M.	Mean of the month.
July	77·8	83·8	80·8	September	73·1	83·1	78·1
August	76·7	82·7	79·7	October	70·6	86·2	78·4

1852.

Months.	SR.	4^h P.M.	Mean of the month.	General mean.	Months.	SR.	4^h P.M.	Mean of the month.	General mean.
January	49·6	71·5	60·5	60·8	July	79·1	84·7	81·9	81·1
February	58·4	83·9	71·1	64·4	August	76·6	80·7	78·6	79·8
March	65·8	85·8	75·8	74·0	September	76·7	83·0	79·8	79·5
April	74·0	94·7	84·3	83·1	October	69·0	83·3	76·1	77·7
May	80·6	96·0	88·2	84·8	November	....	....	....	(70·5)
June	82·1	92·3	87·2	86·7	December	....	....	....	(62·0)

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
62·4	80·6	82·5	75·9	75·4

NAUGÓNG, in Băndelkhănd.

Latitude North.	Longitude East Green.	Height.
25° 3′·5	79° 27′·6?	Ab. 570 feet.

1850-3. ALLEN; TYTLER. SR.; 10; 4; SS.; Min. and SR.; 9^h 50^m; 12; 2^h 40^m; 4^h; SS.; Min. The isolated means of 1851 had to be taken, the original observations being not obtainable, from As. Soc. Journ., 1852; but for want of conformity I excluded them from the mean; they are included in vertical brackets.

Months.	1850			1851			1852			1853			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	....	.....	....	57·4	68·9	63·1	53·5	68·5	61·0	50·6	66·7	58·6	60·9
Febr.	....	.....	....	61·9	74·8	68·3	65·1	80·5	72·8	70·0	87·6	78·8	73·3
March	....	.....	....	70·7	87·1	78·9	67·3	82·3	74·8	66·0	85·0	75·5	76·4
April	74·5	88·9	81·7	....	....	[91·6]	74·8	93·1	83·9	72·8	92·4	82·6	82·7
May	87·8	100·4	94·1	....	....	[96·4]	82·8	96·1	89·4	84·0	96·8	90·4	91·3
June	88·5	101·2	94·8	....	....	[94·8]	85·1	95·0	90·0	....	....	....	92·4
July	84·5	91·0	87·7	82·6	88·2	85·4	82·1	86·2	84·1	....	....	....	85·7
Aug.	82·3	85·9	84·1	81·3	87·1	84·2	81·7	84·7	83·2	82·1	87·8	84·9	84·1
Sept.	81·8	87·1	84·4	78·9	85·7	82·3	80·8	85·5	83·1	81·2	88·8	85·0	83·7
Oct.	76·7	83·6	80·1	75·0	86·2	80·6	74·5	85·3	79·9	....	....	....	80·2
Nov.	63·5	77·6	70·5	....	....	[74·6]	64·0	79·6	71·8	....	....	....	71·1
Dec.	58·1	73·9	66·0	....	....	[67·9]	54·4	67·2	60·8	....	....	....	63·4
Year			....			....	for 1852: 77·9					....	78·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·9	83·5	87·4	78·3	78·8

Orái, in Băndelkhănd.

Latitude North. 25° 59′ — Longitude East Green. 79° 31′ — Height. Ab. 1,700 feet.

1851. Journ. As. Soc., 1852. Approximate means from extremes.
1854. Piddington.

Schlagintweit, "Met. Mscr.," Vol. 27.

Months.	1851.	1854.	Months.	1851.	1854.	Mean.
	Mean of the month.			Mean of the month.		
January	....	65	July	89	91½	90·2
February	....	75½	August	87	87½	87·2
March	....	80	September	86·2	....	....
April	....	90	October	82·5	....	....
May	....	96½	November	68·2	....	....
June	93·5	97	December	....	66	....
	mean 95·2					

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
68·8	88·8	90·9	79·0	81·9

Púri, in Oríssa.

Latitude North. 19° 48′·2 — Longitude East Green. 85° 45′·8 ♄ — Height. L. a. L. S.

1851. Journ. As. Soc., 1852. As shown by the observations for October, for which I got the details, about 1·5 had to be deducted to correct the combination used in the Asiatic Journal.
1854 and some isolated months, but very incomplete, of the preceding years. Dennison; Thiring. SR.; 10; 4; 10.

Schlagintweit, "Met. Mscr.," Vol. 12.

Months.	1851 Mean of the month.	1854 SR.	1854 4h P.M.	1854 Mean of the month.	General mean.	Months.	1851 Mean of the month.	1854 SR.	1854 4h P.M.	1854 Mean of the month.	General mean.
January	70	62·7	73·5	68·1	69·05	July	84·0	82·7	86·1	84·4	84·2
February	74	68·4	77·8	73·1	73·55	August	84·5	83·7	86·1	84·9	84·7
March	81·5	76·8	82·7	79·7	80·6	September	84	82·6	85·3	83·9	83·95
April	85	....	....	....	85·0	October	81·7	....	....	....	81·7
May	86·5	....	....	....	86·5	November	....	74·5	78·6	76·5	76·5
June	85	85·7	87·7	86·7	85·85	December	....	69·4	74·9	72·1	72·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
71·5	84·0	84·9	80·7	80·3

SÁGAR, in Málva.

Latitude North.	Longitude East Green.	Height.
23° 50′·2	78° 43′·4	1,906 feet.

1851. Journ. As. Soc., 1852.
1851 and 1852. SMITH. Approximated means.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 27.

1852,	January	58	1851,	May . . .	91·5	1851,	September	76½
„	February	71½	„	June . . .	92	„	October . .	76½
„	March . .	73	„	July . . .	86	„	November	65½
1852, 1851,	April . .	83, 89 } 86	„	August. .	81¼	„	December	63½

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·5	83·5	86·4	72·8	76·8

SAMULKÓTTAH, in Oríssa.

Latitude North.	Longitude East Green.	Height.
17° 4′	82° 11′	50 feet.

Dec. 1857 to March 1859. Approximate means from Parl. San. Rep., Vol. II., p. 473.

1857 to 1859. Means of the month.							
January	70	April	85	July	79	October	73
February	76	May	85	August	79	November	69
March	80	June	80	September	77	December	68

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
71·3	83·3	79·3	73·0	76·7

SEHÓR, in Málva.

Latitude North.	Longitude East Green.	Height.
23° 12′	77° 1′	1,620 feet.

1852-4. TIMINS. SR.; 9^h 50^m; N.; 2^h 40^m; 4; SS

SCHLAGINTWEIT, "Met. Mscr.," Vol. 27.

Dec. had to be interpolated to obtain the means.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	....	....	48·7	68·4	58·5	51·4	74·9	63·1	60·8
February	57·8	82·5	70·2	54·7	79·2	66·9	51·1	73·9	62·5	66·5
March	63·7	84·1	73·9	64·4	87·8	76·1	....	....	....	75·0
April	71·1	93·8	82·5	71·9	94·6	83·2	74·5	97·6	86·0	83·9
May	79·7	96·7	88·2	....	....	....	82·9	102·4	92·6	90·4
June	75·7	91·2	83·5	81·8	93·1	87·4	82·2	94·2	88·2	86·4
July	77·0	84·6	80·8	....	....	....	77·0	83·0	80·0	80·4
August	74·4	79·8	77·1	74·8	83·7	79·2	75·1	82·7	78·9	78·4
September	72·5	83·1	77·8	72·7	83·6	77·7	74·4	82·7	78·5	78·0
October	68·3	83·4	75·9	63·6	82·8	73·2	66·1	83·0	74·5	74·5
November	56·6	79·9	68·3	58·2	81·2	69·7	61·7	75·5	68·6	68·9
December	....	....	....	....	....	....	....	....	....	(65)
Year			....			....			....	75·7

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·1	83·1	81·7	73·8	75·7

Sitabáldi, in Nágpur, Berár.

Latitude North.	Longitude East Green.	Height.
21° 10′	79° 6′	939 feet.

June 1858 to Dec. 1860. Wyndame. Mean of Extremes. Parl. San. Rep., Vol. II., p. 285.

1858 to 1860.							
Months.	Min.	Max.	Mean of the month.	Months.	Min.	Max.	Mean of the month.
January	61	80	70·5	July	81	84	82·5
February	75	84	79·5	August	80	83	81·5
March	78	77	83	September	80	84	82
April	87	97	92	October	77	85	81
May	92	99	95·5	November	69	79	74
June	86	90	88	December	65	74	69·5

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
73·1	90·2	84·0	79·0	81·6

VIZAGAPATÁM, in Oríssa.

Latitude North.	Longitude East Green..	Height.
17° 41′	83° 21′	L.a.L.S.

1854. Mc'MULL. SR.; 10; 2; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 9.

1859. C. T. SMITH, at the Jail Hospital. Mean of Extremes. Parl. San. Rep., Vol. II., p. 377.

Months.	1854			1859			General mean.
	SR.	4^h P.M.	Mean of the month.	Mean Min.	Mean Max.	Mean of the month.	
January	67·4	75·5	71·4	71	75·5	73·2	72·3
February	73·5	78·4	75·9	75·5	78	76·8	76·3
March	78·6	83·8	81·2	81	85·5	83·2	82·2
April	....	....	....	90·0	96·5	93·3	93·3
May	85·2	89·1	87·1	86·5	88·5	87·5	87·3
June	....	....	....	86·5	89	87·7	87·7
July	....	....	....	84·5	87·5	86	86·0
August	83·5	85·6	84·5	85	87	86	85·2
September	....	....	....	84·5	86·5	85·3	85·3
October	....	....	....	82·5	85·5	84	84
November	....	....	....	78	82	80	80
December	....	....	....	75	77	76	76

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
74·8	87·6	86·3	83·1	22·9

GROUP VII: SOUTHERN INDIA, HILLY DISTRICTS:

1. DÉKHAN AND MAISSÚR.

Ahmadnágar.	Jálna.	Phăltan.
Ballári.	Kădapa.	Púna.
Belgáũ.	Kaládghi.	Purandár.
Bíjapur.	Kărnúl.	Ramandrúg.
Dharvár.	Kírki.	Satára.
French Rocks.	Kólapur.	Serúr.
Gúti.	Mahabaléshvar, Station, and Panchgánni.	Shólapur.
Haiderabád.		Sikăndarabád.
Hărihár.	Merkára.	

For the analysis of the climate of southern India I took the Dékhan and Maissúr together; these mountainous regions allowed me to follow the variation from 20° of Latitude down to 12°. The Nílgiris were kept separately. For these provinces materials from the recent researches about the conditions of the country for sanitaria could be added to those obtained from the medical board.

For the Dékhan, I had found most valuable information in the two well-known papers by Col. Sykes: "On Atmospheric Tides and the Meteorology of the Dékhan,"[1] and "Meteorological Observations taken in India."[2] For Maissúr I had obtained numerous details from General Cullen and his military officers through my late brother Adolphe. I myself had visited these districts, together with my

[1] Phil. Trans. of the Royal Soc., 1835, p. 161-220.

[2] Ibid, 1850, p. 297-378.

brothers, from December 1854 to February 1855, and ADOLPHE again in February and March 1856.

The Dékhan, descending from the western Ghāts, has a pretty considerable mean elevation; on the whole it forms an undulating plateau; the stations are free, without undue exposure to the winds, but at the same time they are but little protected against the general accumulation of heat all round; only isolated points, such as the hill-forts, show a well-marked decrease of temperature with height.

In the *cool season*, from December to February, the sky is but little clouded during the nights, and the temperature sinks considerably by radiation; also during the day-time the air is frequently cooled by refreshing breezes.[1] Dew is very frequent; it first makes its appearance towards the close of the monsun; but it does not become constant and copious till December, continuing then till February. During our journey through the Dékhan we often got sensibly moist, and the water dripped from our hats and plaids. In the hours of the morning also the second depression of the thermometer after sunrise first attracted my attention after I had passed the Ghāts, in a region where it was considerably increased by the evaporation of the copious dew. The deposition of dew is often very local, showing differences in the radiating power which in many instances I found increased by cold air accumulating in depressions.[2]

In Maissúr the lower latitude, as well as the greater narrowness of the peninsula, considerably mitigates the depression of temperature at this season; dews are also exceptional, notwithstanding the considerable moisture by day and night. Fogs are of rare occurrence and to many of the natives of Maissúr quite unknown; in the Dékhan, even on the plateau in its interior, they take place occasionally from October to February, never lasting longer than till about $9\frac{1}{2}$ A.M.; along the Ghāts they prevail for 6 months of the year. At Mahabaléshvar, 4,300 feet high, the temperature in January and February frequently falls as low as 45° Fahr. and by radiation even several degrees below the freezing point.

In the *hot season*, from March to May, the temperature rises rapidly; the circum-

[1] Col. SYKES, "Atmospheric Tides," p. 191, mentions many instances of a most surprising nature. I also found the natives not unacquainted with the irregularities in the deposition of dew, though in few instances only they could judge of the circumstances causing the variations.

[2] For the determination of "*Quantity of Dew*," see Vol. V. of the "Results."

stance that here most of the soil consists of a heavy black earth, very much increases the heating effect of the sun's rays, and for most localities also considerably limits the depression of the temperature during the night. The black trapp-rocks, too, which become of an incandescent heat during the day-time, remain sensibly warm all night, and for many districts materially contribute to limit the depression of temperature.[1]

Hot winds of a north-westerly direction occasionally occur in the Dékhan; but they are neither so regular nor of such extreme heat and dryness as those in the Pănjáb and the valley of the Ganges. The setting-in of the hot season generally takes place in the middle of March, and the temperature begins to rise very suddenly. The hottest months of the year are not the driest; the westerly winds bring over a great quantity of vapour from the Arabian Sea, which, however, rapidly diminishes during its progress to the east.

Westerly winds are felt already early in March, occasionally with heavy rains. In 1853 (April 11th) rain poured down in torrents for a whole hour: 1·89 inch was observed, and the thermometer fell from 90° to 69° Fahr. At the beginning of the hot season there is a periodical alteration between easterly and westerly winds, of some analogy but not quite contemporaneous with the sea-breezes along the shore. As characteristic for the Dékhan, I must add the cold winds from the NNW. and WNW., mentioned already by Colonel SYKES. Also in the registers I find occasionally such depressions by cold winds as made the thermometer sink, even in the middle of March, to 40° Fahr. They are no more observed after the beginning of April.

Hail sometimes falls, but only in the hot months and during thunder-storms.

Near the end of April even at Púna the heat sometimes exceeds 100 degrees, the sun's rays being then nearly vertical for weeks; thunder-storms may occasionally break the heat, but even these are followed by passing clouds and close sultry weather for the next succeeding days.

The transparency of the atmosphere is not disturbed, during the hot season, by fogs, but by suspension of solid matter, forming a dry haze of considerable height. On such days the mornings are quite clear and the haze then gradually increases.

[1] The black soil has a peculiar tedency to get crevassed. It even at times shows deep fissures, which not unfrequently make the roads, always in a very primitive condition, still more difficult of passage for carts. We ourselves used only camels for our luggage.

It is not a wholly local phenomenon, but seems to depend upon the gradual increase of temperature—a condition which must materially modify the height up to which suspended matter can be carried. In coincidence with this consideration I find in Maissúr and in the Dékhan such hazes only noted as beginning *after* an uninterrupted succession of pretty warm days. When strong, they show that the hot weather will continue for some time.

From the Ghāts such hazes can also be seen over the Kónkan. But from the fact that they are not observed at Bombay, they seem to be a veil nearer to the Ghāts than to the sea-shore.

In Maissúr the heat is less intense, the considerable elevation also contributing somewhat to reduce it; but at the same time the atmosphere is very often felt extremely close. Here, as well in Sindh, we had occasion to observe many instances of the surprising distance over which the sea-breezes can be felt.

The *rainy season* occasionally begins with the month of June by thunder-storms and heavy showers; so from Sattára to Bangalúr, in 1853; more frequently the wind remains very variable till nearly the latter part of the month, though the first setting-in of the monsún takes place early in June. When, for a day or two, the monsún is interrupted, the heat again rises considerably, and such periods are the most unhealthy times of the year; at Ellór a temperature of 110° Fahr., and even of 112° Fahr., have been observed.

Along the Ghāts separating the Dékhan from the Kónkan the quantity of rain is greatest. Mahabaléshvar is, next to the Khássia-hills, the station where the greatest amount of rain has been observed; and though this excessive quantity is limited to a very small district, the average fall of rain all along the western Ghāts remains very considerable; but in the eastern part of the Dékhan it rapidly decreases. Maissúr, notwithstanding its comparatively short distance from either shore, only gets the principal amount of rain with the monsún from the south-west; but as to the increase of moisture, and *occasionally* of rain, the monsún of the eastern shore also begins to have some influence. The Malabár, or south-west, monsún sets in June; towards the end of September it is followed by the Koromandel, or north-east, monsún. This extends the period of the rains; the greatest quantity, however, falls during the south-west monsún, the Koromandel wind causing only some increase in October. The total amount of rain is not excessive. The greatest quantity of rain falls in

June and July, the month of October—not August or September—is the next most rainy month; but the number of its rainy days is limited, and the precipitation chiefly takes place during squalls and storms.

In the eastern parts of the Dékhan the precipitation is, in many a year, scarcely sufficient for the cultivation of the soil, or to compensate for the loss of moisture by heat and evaporation; the price of food has often been known to reach a degree approaching a real famine; but, local as it is, it is to be hoped that the improvement of the means of communication will gradually prevent the recurrence of this plague.

The bed of the rivers and their banks are, after the rains, full of organic matter left to decay. In some instances we found, even in the cold season, a slimy stratum covering the bottom of the rivers, and making it so slippery that we had great difficulty in getting our loaded camels through.

In *autumn* the mean temperature of the three months September, October, and November begins to show an irregularity in the yearly variation which is characteristic for the southern parts of India, and which has only the chance of appearing where the difference altogether between the single months is not very great. September differs but little from August; October, again, is warmer than September, chiefly when the cessation of the rains and the disappearance of the clouds allows a more powerful action of the rays of the sun. Already in November the delightful refreshing mornings begin to become regular and general.

For the *Dékhan plateau* I give in the following table the means carefully calculated by Colonel SYKES, from the memoir quoted above.

[1] Also in the jăngly districts of Central India this peculiar modification of the bottom of the rivers predominates. In crossing the Nărbáda ROBERT lost two camels, which got their hind legs dislocated (or "got split," as the native said) whilst unsuccessfully attempting to keep upright in the river. The current was so weak that it had nothing to do with the accident.

Dékhan plateaux, general mean values of the temperature of the air.

A. 1825, between Lat. N.: 18½ to 19′·6; Long. E. Gr.: 73½—74¾. Mean height: 1700 feet.

January	71·9	May	83·8	September	79·2
February	75·9	June	85·0	October	81·1
March	77·3	July	80·3	November	78·1
April	81·1	August	80·7	December	66·9
		Year 78·5			

B. 1826, Lat. N.: 18—19′·1; Long. E. Gr.: 73·4 to 74·8. Mean elevation 1800 feet.

January	65·9	May	83·3	September	76·6
February	71·8	June	78·7	October	80·3
March	77·6	July	76·4	November	75·8
April	81·5	August	77·0	December	73·6
		Year 76·5			

C. 1827, Lat. N.: 17·4—19·4; Long. E. Gr.: 73·4—75·9. Mean height: 1700 feet.

January	71·7	May	84·4	September	77·4
February	73·9	June	80·1	October	78·1
March	77·4	July	77·0	November	76·0
April	....	August	76·1	December	72·8

D. 1828, Lat. N.: 17·7—19·2; Long. E. Gr. 73·4—75·9. Mean height: 1800 feet.

January	76·0	May	83·7	September	76·9
February	76·4	June	83·2	October	77·7
March	....	July	77·8	November	76·4
April	83·3	August	78·0	December	68·3

Some remarks about the Hill-stations of northern India will be found in the general sanitary registers of Dr PEARCE, Principal-Inspector-General.

For the variation of *absolute extremes* I give several examples from these districts, on account of the great variety of heights and localities: also for the insolation I selected from my meteorological data two stations widely differing in height. For Kădapa it is the mean of 1852, 1853, and 1854; for Bangalúr of 1853 and 1854.

Absolute Extremes.

Sattára, 2,320 feet. 1844—7. Observer: Dr. Murray.

Months.	Min.	Max.	Months.	Min.	Max.
January	53	86	July	60	91
February	50½	90	August	60	80
March	62	100	September	64	83
April	64	102	October	63	93
May	70	103	November	58	85
June	69	93	December	57	86

Mahabaléshar, 4,300 feet. 1829—43. Observers: Drs. Walker, Morhead, and Murray.

Months.	Min.	Max.	Extreme lowest temp. by radiation.	Months.	Min.	Max.	Extreme lowest temp. by radiation.
January	45	79½	30	July	51½	73·8	....
February	46	85½	31½	August	53	70·8	....
March	49½	89	33	September	56	77	....
April	56	92	36½	October	54	78½	34·1
May	57⅓	90	30·2	November	51½	75	29½
June	53	84	....	December	48½	76	27½

Bellári, 1,583 feet. 1853—4. Observer: Dr. Syre.

Months.	Min.	Max.	Months.	Min.	Max.
January	61	83	July	74	89
February	69	89	August	75	89
March	74	94	September	75	87
April	79	100	October	68	87
May	80	100	November	71	87
June	78	98	December	66	84

Bangalúr, 2,949 feet. 1853 and 1854. Observers: Drs. BUTLER and RICHMOND.

Months.	Min.	Max.	Months.	Min.	Max.
January.......	62	80	July	65	87
February......	62	90	August	66	86
March	68	93	September	68	85
April	65	96	October........	68	84
May	71	94	November	59	81
June	68	89	December	58	78

Mean Insolation.

Months.	Kådapa, 364 feet.	Bangalúr, 2,949 feet.	Months.	Kádapa, 364 feet.	Bangalúr, 2,949 feet.
January......,	104	110	July	93	93
February......	107	118	August	99	93
March	114	112	September	94	92
April	115	107	October........	98	95
May	115	110	November	94	97
June	107	102	December	100	104

As a Plate to be compared, the Panoramic view of the *Kúnda Range*, the sea-ward flank of the Nilgíris, can be quoted. The atmosphere shows the blue of that intense tint and deepness peculiar to the sky when affected already by the ascending haze of a tropical afternoon of unbroken heat. Also the mountain ridges, notwithstanding their various distances, partake, all of them, of the prominent type of the atmospheric colour, most distinctly in their shaded sides. Part I., No. 8, Or. No. 139.

AHMADNÁGER, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
19° 6′	74° 46′	2,133 feet.

A. 1828. Mean of the year from observations by Dr. WALKER, communicated by Col. SYKES. in Phil. Trans., 1835, p. 181.

Mean of the year (1828) . . . . 78.

B. 1859. CAMERON. The observations were made at the artillery hospital, with particular care. The "Mean" of the day is derived from the observations in the morning and in the afternoon, and it is but little cooler or warmer than the direct mean of the extremes would give it. Parl. San. Rep., Vol. II., p. 837.

1859.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	59·7	82·0	71·4	July	74·2	84·3	79·1
February	64·7	87·8	76·7	August	71·4	82·0	76·3
March	68·4	91·9	80·0	September	70·8	80·9	75·7
April	75·1	95·1	85·5	October	68·1	86·0	77·3
May	76·0	99·8	87·4	November	66·1	85·3	77·4
June	74·5	87·7	80·4	December	59·0	80·9	70·2

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·8	84·3	78·6	76·8	78·0

BALLÁRI (Bellári), in Maissúr.

Latitude North.	Longitude East Green.	Height.
15° 8′·9	76° 53′·8♁	1,538 feet.

1839. Isolated months in Indian Journal of Med. Sc., old series, Vol. VIII., p. 71, without the indication of the combination of the hours.

1852-4. SYRE. 1852-3: SR.; 10; 2; 4; SS. 1854: SR.; 10; 2; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 10.

(1851-9. Means in Parl. San. Rep., Vol. II., p. 415. Too warm throughout the year, probably in consequence of taking the mean of all the hours of observation.)

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	68·8	77·9	73·3	69·5	77·9	73·7	68·9	79·9	74·4	73·8
February	71·8	82·1	76·9	73·5	83·8	78·6	72·5	84·7	78·6	78·0
March	78·5	87·5	83·0	79·7	90·0	84·8	80·0	93·5	86·7	84·8
April	82·5	90·5	86·5	82·1	90·2	86·1	83·8	95·8	89·8	87·5
May	78·7	86·4	82·5	85·1	91·9	88·5	81·7	94·5	88·1	86·4
June	77·2	84·2	80·7	79·6	86·8	83·2	80·5	91·4	85·9	83·3
July	75·8	83·0	79·4	76·3	82·2	79·2	76·9	85·7	81·3	80·0
August	74·6	80·3	77·4	78·3	83·8	81·0	76·8	87·3	82·0	80·1
September	70·2	80·4	75·3	76·4	84·4	80·4	75·5	83·5	79·5	78·4
October	73·5	80·3	76·9	76·6	85·9	81·2	74·5	82·4	78·4	78·8
November	70·8	79·6	75·2	75·8	83·5	79·6	73·0	81·0	77·0	77·3
December	67·7	75·3	71·0	68·7	80·2	74·4	70·4	79·6	75·0	73·5
Year	for 1852: 78·2			for 1853: 80·9			for 1854: 81·4			80·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·1	86·2	81·1	78·2	80·2

BANGALÚR, in Maissúr.

Latitude North.	Longitude East Green.	Height.
12° 57′·6	77° 33′·5♁	2,949 feet.

1835. MOUAT, Journ. As. Soc., V., p. 297.

1838. Ind. Journ. of Med. Science, old series, Vol. VIII., p. 71. Extremes and approximated means, without any indication about the combination of the hours. This I left out.

1839, April to February 1840: 6^h A.M. and 3^h, 8^h P.M. (MOUAT, Ind. Journ. of Med. Sc., old series, Vol. IX., p. 460.) But the 3^h P.M. readings seem decidedly affected by insolation. Also their difference from the thermometer exposed to the sun is but very small.

1844-5. Journ. Nat. History, Vol. VI., p. 370. Only extremes and a very good characteristic of the climate in general.

1853-4. BUTLER; RICHMOND; 1853: SR.; 10; 4; SS. — 1854: SR.; 10; 2; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 10.

Months.	1835	1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	69½	66·6	75·6	71·1	61·1	74·6	67·8	69·5
February	72½	66·0	79·5	72·7	64·4	77·8	71·1	72·1
March	78¾	71·8	84·9	78·3	69·5	86·0	77·7	78·2
April	78½	72·0	83·4	77·7	75·6	90·5	83·0	79·7
May	78½	75·7	84·9	80·3	78·7	87·4	83·0	80·6
June	75¼	69·3	78·3	73·8	72·3	82·8	77·0	75·3
July	73¾	67·2	76·6	71·9	69·9	78·2	74·0	73·2
August	73¾	68·0	77·4	72·7	72·4	81·4	76·9	74·4
September	73¾	67·6	80·1	73·8	71·9	79·0	75·4	74·3
October	70½	69·4	77·9	73·6	71·0	77·5	74·2	72·8
November	71·4	67·1	77·3	72·2	67·5	74·2	70·8	71·5
December	69¼	61·7	74·6	68·1	65·6	73·9	69·7	69·0
Year	73·5	for 1853: 76·8			for 1854: 75·0			74·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
70·2	79·5	74·3	72·9	74·2

Belgáũ, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
15° 50′	74° 32′	2,180 feet.

A. 1828. From Balfour's Barometric selections, p. 31.
(In the original February is 84, March 72, instead of 74, 82, which I think, must be considered as a typographical error.)
This series I did not include in the mean.

B. 1856-9. Walter. Very good instruments; but no details of the hours being given in the Parl. San. Rep., Vol. II., p. 705, and the "mean dry bulb" being generally warmer than the mean of the extremes, I preferred taking the mean of these, since they decidedly differ less from the true mean.

A. 1828.

January	70	April	81·5	July	74	October	73·5
February	74	May	84	August	74·5	November	70·5
March	82	June	82	September	74	December	68

Mean of the year: 75·6.

B. 1856 to 1859.

Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	56·6	85·1	70·8	July	66·1	78·7	72·4
February	58·6	90·5	74·6	August	64·7	77·9	71·3
March	61·8	94·3	78·0	September . . .	64·0	80·3	72·2
April	65·6	96·5	81·0	October	62·4	85·0	73·7
May	66·3	89·3	77·8	November	61·5	83·5	72·5
June	65·7	80·9	73·3	December	56·6	82·6	69·6

General mean of the seasons and of the year (1856 to 1859).

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
71·6	78·9	72·3	72·8	73·9

Bíjapur, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
16° 50′	75° 47′	Ab. 1,700 feet.

1848. Col. Sykes. Means. Phil. Trans., 1850, p. 324.

1848. Mean of the month.					
January	78·5	May	88·5	September	78·2
February	75·3	June	85·0	October	76·6
March	84·8	July	81·2	November	76·7
April	88·4	August	78·7	December	79·2

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
77·7	87·2	81·6	77·2	81·0

Dharvár, in Maissúr.

Latitude North.	Longitude East Green.	Height.
15° 27′	75° 1′	2,423 feet.

A. 1827, January to August. Christie. Edinb. Phil. Journ., 1828, p. 304.

B. 1859, January to April 1860. Joynt. Approximations, evidently too warm; no details are given in Parl. San. Rep., Vol. II., p. 865. I deduced from this series—by corrections analogous to the differences of the other months—values for completing the annual cycle from Sept. to Dec.

1827, Jan. to Aug.; 1859, Sept. to Dec.					
January	70·2	May	80·3	September	72·7
February	74·7	June	74·8	October	75
March	77·2	July	72·9	November	76
April	80·4	August	72·7	December	71

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·0	79·3	73·5	74·6	74·8

French Rocks, in Maissúr.

Latitude North.	Longitude East Green.	Height.
12° 31′	76° 40′	2,620 feet.

The height of this fort, 5 miles north of Seringapatám, is stated, in "Medic. Topogr. of Mysore," p. 85, to be 300 feet above the Káveri river, for which Cullon had found near the station 2,321 feet. The temperatures given in Dove's "Nichtperiodischen Temperaturverhältnissen," IV., p. 103, for Seringapatam, are the observations for French Rocks for 1816.

1814-16. Scarman, in Brewster's Edinb. Journ. of Soc., V., p. 258.

1853-54. Supple; White. Daily means deduced from Max. and Min., read with the ordinary, not with registering, thermometers.

Schlagintweit, "Met. Mscr.," Vol. 10.

Months.	1814	1816	Mean 1853-54	General mean.	Months.	1814	1816	Mean 1853-54	General mean.
January	72½	69	76·8	72·8	July	76⅓	73¼	76·6	75·4
February	79½	74	79·2	77·6	August	73½	74	75·5	74·3
March	81¾	79¾	82·8	81·4	September	77¾	75½	77·5	76·9
April	85½	83	82·0	83·5	October	78	76½	76·7	77·1
May	86½	83½	81·7	83·9	November	76¼	72	76·7	75·0
June	80	77¾	79·9	79·2	December	73½	71	76·6	73·7
					Year	78·4	75¾	78·5	77·6

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
74·7	82·9	76·3	76·3	77·6

GÚTI, in Maissúr.

Latitude North.	Longitude East Green.	Height.
15° 6′·9	77° 38′·1 ♁	1,115 feet.

1855. Isolated months, Capt. O'CONNEL. Mean of daily extremes. ADOLPHE left there, in Febr. 1855, one of our thermometers; he got no observations communicated after June 1855.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 10.

1855

February . .	79·7	April	90·5
March	85·1	June	84·2

HAIDERABÁD, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
17° 22′	78° 32′	1,800 feet.

Aproximated means, communicated to me by Dr. BALFOUR.

January	74½	July	81
February	76½	August	80½
March	84	September	79
April	91½	October	80
May	93	November	76½
June	88	December	74½

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75	89½	83	78½	81½

Hărihăr, in Maissúr.

Latitude North.	Longitude East Green.	Height.
14° 31′	75° 51′	1,831 feet.

1853. Baillie; Williams. SR.; 10; 4; SS. Schlagintweit, "Met. Mscr.," Vol. 10.

1857, June to 1859, January. Means, the hours not detailed, are contained in Parl. San. Rep., Vol. II., p. 497.

1853.

Months.	SR.	4^h P.M.	Mean of the month.	Months.	SR.	4^h P.M.	Mean of the month.
January	68·8	79·3	74·0	July	73·1	78·5	75·8
February	69·3	88·5	78·9	August	74·8	82·7	78·7
March	77·1	95·1	86·1	September	75·3	82·7	79·0
April	80·0	95·4	87·7	October	74·1	87·4	80·7
May	83·8	89·7	86·7	November	72·6	86·1	79·3
June	77·3	85·1	81·2	December	66·5	83·5	75·0

Mean for 1853: 80·3.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
76·0	86·8	78·6	79·7	80·3

Jakatálla, near the military station Wellington, in the Nílgiris.

Latitude North.	Longitude East Green.	Height.
$11^1/_3$°	$76^2/_3$°	Ab. 6,000 feet.

Madras Sanitaria Reports, p. 21; no year or hours of observation being indicated.

Mean of the months.

January	59	April	68	July	70	October	63
February	61	May	68	August	70	November	61
March	67	June	64	September	70	December	60

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
60·0	67·7	68·0	64·7	65·1

JÁLNA, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
19° 51′	75° 54′	1,652 feet.

1853 and 1854. FLEMMING. SR.; 10; 4; SS.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 10.

Months.	1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	71	77	74·0	72	77·3	74·6	74·3
February	69	80	74·5	72	80	76·0	75·7
March	79	86	82·5	80	88	84·0	83·2
April	80	90	85·0	84	94	89·0	87·0
May	82	95	88·5	87	96	91·5	90·0
June	80	87	83·5	77	88	82·5	83·0
July	75	79	77·0	76	79	77·5	77·2
August	77	81	79·0	77	81	79·0	79·0
September	76	79	77·5	75	78	76·5	77·0
October	78·25	83·3	80·8	75	81	78·0	79·4
November	76	83	79·5	72	77	74·5	77·0
December	70	77	73·5	69	74	71·5	72·5
Year	for 1853: 79·6			for 1854: 79·5			79·6

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
74·2	86·7	79·7	77·8	79·6

Kắdapa, in Maissúr.

Latitude North.	Longitude East Green.	Height.
14° 28′·8	78° 48′·4♉	364 feet.

1852-4. Kin. 1852-3: SR.; 10; 4; SS. 1854: SR.; 10; 2; 4; 10.
Schlagintweit, "Met. Mscr.," Vol. 10.

1859. Howell. Extremes and "Mean"; the latter including SS. is warmer than the mean of the extremes which in these latitudes themselves are already rather warmer then the true mean. I preferred deducing the values from the extremes; Parl. San. Rep., Vol. II., p. 518. This latter series had not yet been included in the means I published in the Transactions of the Royal Society.

Months.	1852			1853			1854			1859			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	Min.	Max.	Mean of the month.	
Jan.	73·3	81·8	77·2	74·0	80·2	77·1	71·2	81·0	76·1	74	78	76	76·8
Febr.	74·7	84·8	79·7	71·7	84·8	78·2	76·5	86·3	81·4	74	82	78	79·3
March	81·8	90·6	86·2	79·5	94·1	86·8	82·7	93·3	88·0	79	89	84	86·3
April	86·5	94·9	90·7	84·4	92·8	88·6	88·6	98·0	93·3	86	90	88	90·1
May	84·6	91·1	87·8	88·6	97·3	92·9	89·1	98·0	93·5	86	93	89·5	90·9
June	85·2	91·1	88·1	85·6	93·2	89·4	86·4	92·6	89·5	86	91	88·5	88·9
July	(85·2)	(91·1)	(88·1)	....	....	(87·4)	82·0	87·5	84·7	83	87	85	86·3
Aug.	80·4	85·5	82·9	80·6	87·0	83·8	83·1	86·1	84·6	82	86	84	83·8
Sept.	79·4	83·4	81·4	82·4	88·0	85·2	81·0	85·3	83·1	83	87	85	83·7
Oct.	78·8	82·3	80·5	81·0	86·5	83·7	79·3	83·3	82·6	83	85	84	82·7
Nov.	75·1	80·1	77·6	75·2	81·4	78·3	75·8	79·2	77·5	73	77	75	77·1
Dec.	71·8	77·1	74·4	69·4	78·3	73·8	72·4	77·2	74·8	73	77	75	74·5
Year	for 1852: 83·7			for 1853: 83·8			for 1854: 84·1			for 1859: 82·7			83·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
76·9	89·1	86·3	81·2	83·3

KÁLADGHI, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
16° 12′·9	75° 29′·9 ♉	1,744 feet.

1855-9. MENNIE. Mean of extremes. Parl. San. Rep., Vol. II., p. 875.

1855 to 1859.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	60	89	74·5	July.	73	82	77·5
February	66	92	79	August	73	83	78
March.	74	101	87·5	September	73	82	77·5
April	74	104	89	October.	68	79	73·5
May	74	101	87·5	November	63	76	69·5
June	72	96	84	December.	60	72	66

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
73·2	88·0	79·8	73·5	78·6

Kărnúl, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
15° 49′·9	78° 2′·1 ♁	Ab. 900 feet.

1852-4. Simpson. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 10.

1857-9. Parl. San. Rep., Vol. II., p. 462. Left out the "Mean Dry Bulb," it being marked as unintelligible in the official paper.

Months.	1852			1853			1554			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	76·8	85·7	81·2	73·7	82·4	78·0	74·3	80·5	77·4	78·9
February	76·8	85·7	81·2	75·2	85·6	80·4	77·7	84·8	81·2	80·9
March	82·9	90·7	86·8	77·6	96·1	86·8	81·1	92·4	86·7	86·8
April	86·6	95·4	91·0	85·7	92·7	89·2	90·0	97·5	93·8	91·3
May	83·0	89·5	86·2	89·6	95·5	92·5	89·2	95·6	92·4	90·4
June	82·4	88·1	85·2	86·6	90·9	88·7	84·5	89·5	87·0	87·0
July	81·3	85·7	83·5	80·8	85·1	82·9	79·3	82·6	80·9	82·4
August	77·8	82·9	80·3	80·2	84·8	82·5	82·5	87·0	84·7	82·5
September	78·9	84·0	81·4	82·3	85·1	83·7	79·7	84·2	81·9	82·3
October	79·6	79·0	79·3	82·0	85·7	83·8	78·7	84·0	81·3	81·5
November	74·0	83·9	78·9	74·7	82·7	78·7	76·6	81·5	79·0	78·9
December	69·8	77·8	73·8	75·5	83·5	79·5	74·4	79·9	76·6	76·6
Year	for 1852: 82·4			for 1853: 83·9			for 1854: 83·6			83·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
78·8	89·5	84·0	80·9	83·3

Kírki, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
18° 33′·5	73° 50′·25	1,850 feet.

1851-3. Means, communicated by Manestry.

Schlagintweit, "Met. Mscr.," Vol. 39.

1851. Mean of the month.

April . . .	81	July . . .	77	October. .	81
May . . .	84	August . .	75	November	78
June . . .	78	September	73	December	71

1852. Mean of the month.

January. .	71	April . . .	82	July	77	October. .	79
February .	76	May. . . .	81	August . .	75	November.	76
March . .	79	June . . .	79	September	77	December.	71

Year: 77·0.

1853. Mean of the month.

January. .	71	February .	74	March. . .	83

General mean of the month.

January. .	71·0	April . . .	81·5	July	77·0	October . .	80·0
February .	75·0	May. . . .	82·5	August . .	75·0	November.	77·0
March. . .	81·0	June . . .	78·5	September	75·0	December.	71·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·3	81·7	76·8	77·3	77·0

Kólapur, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
16° 42′	74° 15′	1,797 feet.

1850-9. Wicke. Mean of extremes. Parl. San. Rep., Vol. II., p. 693.

1850 to 1859.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	66·7	77·2	71·9	July	74	77	75·5
February	69·2	81·6	75·4	August	73·4	76·7	75·0
March	75·3	87·0	81·1	September	73·8	77·9	75·8
April	76·3	88·0	82·1	October	74·6	80·0	77·3
May	76·6	88·8	82·7	November	71·7	78·3	75·0
June	75·8	81·4	78·6	December	66·8	76·5	71·6

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
73·0	82·0	76·4	76·0	76·9

Mahabaléshvar, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
17° 54′·4	73° 38′·7 $\frac{1}{5}$	4,300 feet.

1829-43. Col. Sykes, Phil. Trans., 1850, p. 324. SR.; 10; 4; 10. Schlagintweit, "Met. Mscr.," Vol. 33.

A. Mahabaléshvar station.

1829-43. General mean of the month.							
January	64·0	April	74·5	July	63·2	October	66·6
February	66·3	May	72·4	August	63·2	November	64·4
March	71·5	June	66·3	September	63·9	December	63·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
64·5	72·8	64·2	65·0	66·6

B. Panchgánni station, 4,000 feet.

The means are taken from a Report on the Hill Sanitaria of Western India, 2nd Report on the Hill station Panchgánni, by JOHN CHESSON. Bombay Alliance Press, 1862. The thermometer was observed SR.; 10; 12; 4; SS.; 8^h 1854-62, but in a tiled house, therefore the means are only approximations. I add them, since, the quantity of rain being considerably less heavy, it is much better adapted to a continued residency of Europeans than Mahabalēshvar. In an official letter from the Revenue department, Febr. 25, 1863, a copy of which I got communicated by AD. ROBERTSON, Esq., secretary to government, it is thus defined: "It is evidently more congenial as a continued residence to Europeans who have been long in India, and to their children, than any other Bombay station; and a number of independent and respectable Europeans of good character and some means have settled there, invested a large sum in the purchase of land and in building houses, and are living there under circumstances creditable alike to them and to the country of their origin, and beneficial not only to themselves and their families, but to the natives around them."

Mean of the months.

January	66	April	77	July	66	October	67
February	71	May	76	August	65	November	67
March	75	June	69	September	65	December	65

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·3	76·0	66·7	66·3	69·1

Merkára, in Maissúr.

Latitude North.	Longitude East Green.	Height.
12° 24′	75° 45′	4,506 feet.

1838-40. Blest. Rep. Brit. Ass., 1842, p. 23. Max., Min.
1852-54. Paul; Williams. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 10.

Months.	1838-40	1852			1853			1854			General mean.
	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	66·6	....	....	....	62	78	70·0	66	77	71·5	69·4
February	70·8	69	76	72·5	66	81	73·5	67	79	73·0	72·4
March	73·7	75	79	77·0	76	82	79·0	73	82	77·5	76·8
April	73·1	75	79	77·0	71·6	80·3	75·9	74	81	77·5	75·9
May	71·9	72	74	73·0	71	79	75·0	74	80	77·0	74·2
June	69·1	69	70	69·5	67	70	68·5	67	72	69·5	69·1
July	67·1	68	69	68·5	65	67	66·0	66	68	67·5	67·3
August	66	66·6	67·7	67·1	66	68	67·0	67	69	68·0	67·0
September	65·6	67	68	67·5	70	71	70·5	66	69	67·5	67·8
October	66·8	70·5	71·5	71·0	68	74	71·0	68	71	69·5	69·6
November	66·5	69	73	71·0	68	77	72·5	67	73	70·0	70·0
December	64·4	65	76	70·5	64	79	71·5	67	75	71·0	69·3
Year	68·5			....			....	for 1854: 71·6			71·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
70·4	75·6	67·8	71·5	71·3

PANCHGÁNNI, see MAHABALÉSHVAR.

PHÁLTĂN, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
17° 59′	74° 26′	Ab. 1,700 feet.

1847. Col. SYKES. Means. Phil. Trans., 1850, p. 324.

1847. Mean of the months.			
January	74·8	July	80·2
February	76·9	August	79·3
March	83·9	September	78·9
April	83·9	October	80·0
May	86·1	November	73·5
June	81·2	December	72·9

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
74·9	84·6	80·2	77·5	79·3

PÚNA, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
18° 30′·4	73° 52′·1	1,784 feet.

1825-9. Col. SYKES. Phil. Trans., 1855, p. 161. Means of SR. and 4^h P.M. Particularly careful observations.

1856, April, to March 1860. An observatory liberally provided with instruments has been put up now; it is under the charge of Dr. CHAPPLE, with two non-commissioned officers as assistants. In order not to interfere with the easy comparison of the mean of the different periods deduced from SR. and 4^h P.M., the minima and maxima are given at the foot of the general tables.

Months.	1825	1826	1827	1828	1829	Mean *A*.	1856-60. Mean *B*.	General mean.
	Mean of the month.							
January	72·0	65·9	71·7	76·0	67·7	70·7	68·7	69·8
February	75·9	71·8	73·9	76·4	70·6	73·7	75·7	74·7
March	77·3	77·6	77·4	79·9	78·3	74·1	78·2	76·1
April	81·2	81·5	85·8	83·3	78·1	82·0	83·6	82·8
May	83·8	83·3	84·4	83·7	76·1	82·3	82·4	82·3
June	85·0	78·8	80·1	83·2	76·8	80·8	79·1	79·9
July	80·4	76·4	77·0	77·8	75·5	77·4	76·1	76·8
August	80·7	77·0	76·1	78·0	73·8	77·1	74·3	75·7
September	79·2	76·6	77·4	76·9	75·4	77·1	74·2	75·6
October	81·1	80·3	78·1	77·7	78·4	79·1	75·8	77·4
November	78·2	75·8	76·0	76·4	75·7	76·4	73·7	75·0
December	66·9	73·6	72·8	68·3	71·2	70·6	68·7	69·6
Year	78·5	76·5	77·6	78·1	74·8	76·8	75·8	76·3

General mean of the seasons and of the year (from *A* and *B*).

	Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
A.	71·7	79·5	78·4	77·5	76·8
B.	71·0	81·4	76·5	74·6	75·8
Mean	74·4	80·4	77·5	76·0	76·3

C. Mean Minima and Maxima for 1856 to 1860.

Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	88·0	81·2	69·6	July	70·3	80·0	75·1
February	62·9	87·0	74·9	August	68·7	78·3	73·5
March	68·4	91·2	79·8	September	67·6	79·0	73·3
April	71·4	94·6	80·0	October	66·2	84·0	75·1
May	73·9	92·7	78·3	November	61·3	83·2	72·3
June	71·8	84·7	78·2	December	57·7	80·2	64·0

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
69·5	79·3	75·6	73·6	74·5

PURANDÁR in the Dékhan.

Latitude North.	Longitude East Green.	Height.
18° 16′·6	73° 57′·3 ♁	3,974 feet.

1855-7. SR. and 2^h P.M. The observations were begun there at my special request, and I had selected the place for the position of the instruments. Later I found a series of monthly means, without year or further details, in MACPHERSON'S Madrás Sanitaria Reports, 1862, p. 21. They show, however, so little variation in the yearly period, that I thought better to exclude them from the mean.[1]

Months.	1855	1856	1857	General mean.	Months.	1855	1856	1857	General mean.
January	....	68·0	66·6	67·3	July	65·0	65·5	....	65·2
February	....	67·9	71·5	70·2	August	64·5	65·0	....	64·7
March	....	77·6	....	77·6	September	64·3	65·3	....	64·8
April	....	80·1	....	80·1	October	65·5	69·7	....	67·6
May	....	77·6	....	(77·6)	November	68·2	68·2	....	68·2
June	70·9	68·4	....	69·6	December	65·2	65·3	....	65·2
					Year	....	69·9	....	69·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
67·6	78·4	66·5	66·9	69·8

[1] The values are:

Januar	67	April	78	July	67	October	71
Februar	73	May	73	August	65	November	69
March	77	June	70	September	67	December	64

Ramandrúg, in Maissúr.

Latitude North.	Longitude East Green.	Height.
15° 7′	76° 19′	3,363 feet.

A. D. Macpherson, in his general Report in Parl. San. Rep., vol. II., p. 638. The year of observation is not specified.

Mean of the months.

January	70	April	80	July	71	October	71
February	76	May	75	August	70	November	71
March	80	June	73	September	70	December	67

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
71·0	78·3	71·3	70·6	72·8

B. Another series for 1859-60, previously communicated by Dr. Macpherson in the Madras Sanitaria Reports, p. 51 is decidedly too warm, which is evidenced by a comparison with Bangalúr, or by the analogy of the respective isothermal lines.

The values given there are:

Mean of the months.

anuary	74	April	79	July	77	October	77
February	88	May	84	August	74	November	75
March	80	June	76	September	72	December	74

Mean of the year 77·9

SATÁRA.

Latitude North.	Longitude East Green.	Height.
17° 41′	74° 2′	2,320 feet.

1844-7. Col SYKES. Means. Phil. Trans., 1850, p. 324.

1844-7. General Means.					
January	70·0	May	80·1	September	74·0
February	72·6	June	77·0	October	76·1
March	77·8	July	73·8	November	72·0
April	80·6	August	73·0	December	71·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
71·5	79·5	74·6	74·1	75·0

SERINGAPATÁM, *see* FRENCH ROCKS.

Serúr, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
18° 50′	74° 25′	1,752 feet.

Jan. 1 1854 to Oct. 31 1858. Coles. Mean of daily extremes. Parl. San. Rep., vol. II.. p. 898.

Mean of the months.

January	73	April	87	July	76	October	77
February	72	May	84	August	76	November	75
March	81	June	81	September	76	December	72

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·3	84·0	77·6	76·0	77·5

Shólapur.

Latitude North.	Longitude East Green.	Height.
17° 40′	75° 58′	Ab. 1,700 feet.

1852 and 1853. Means communicated to me in the Bombay Observatory.

Schlagintweit, "Met. Mscr.," Vol. 2.

1850-60. Approximated means, not detailed, in the Parl. San. Rep., Vol. II., p. 782; are excluded, as they show too little variation in the yearly period, when compared with the series given below and with the neighbouring stations.

1852 and 1853. Mean of the months.							
January	74½	April	89	July	82	October	78
February	80	May	85	August	81	November	74
March	83	June	85	September	80	December	73

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·8	85·7	82·7	77·3	80·4

SIKĂNDARABÁD, in the Dékhan.

Latitude North.	Longitude East Green.	Height.
17° 26′·7	78° 28′·0 ♁	1,830 feet.

1852-4. RICHMOND; HICKENS. 1852-3: SR.; 10; 4; SS. 1854: SR.; 10; 2; 4; 10. — SCHLAGINTWEIT, "Met. Mscr.," Vol. 10.

1850-9. Parl. San. Rep., Vol. II., p. 344 The mean of this series is, from improper combination, decidedly too warm; as I had no details except those for 1852 to 1854, obtained by myself in India, I left out the other years.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	58·0	76·2	67·1	63·6	75·5	69·5	60·5	75·5	68·0	68·2
February	61·5	81·0	71·2	64·0	87·5	71·2	65·4	73·8	69·6	70·1
March	70·5	85·0	77·7	69·5	86·7	78·1	76·3	91·7	84·0	79·9
April	74·7	89·2	81·9	74·2	89·0	81·6	83·2	98·3	90·7	84·7
May	78·3	87·5	82·9	85·5	92·5	89·0	84·2	96·8	90·5	87·5
June	73·2	82·0	77·6	76·5	85·5	82·0	80·5	92·0	86·2	81·9
July	71·7	79·0	75·3	77·5	82·5	80·0	75·1	82·4	78·7	78·0
August	71·0	79·5	57·2	73·5	81·5	77·5	76·3	85·1	80·7	77·8
September	71·5	80·0	75·7	72·5	80·5	76·5	74·0	81·3	77·6	76·6
October	67·7	80·5	74·1	72·9	82·1	77·5	74·1	81·6	77·8	76·5
November	66·2	80·0	73·1	79·1	78·8	78·9	70·0	79·3	74·6	75·5
December	55·7	75·7	65·7	73·5	78·5	76·0	66·7	76·9	71·8	71·2
Year	for 1852: 74·8			for 1853: 78·1			for 1854: 79·2			77·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
70·0	84·0	79·2	76·2	77·4

2. THE NÍLGIRIS.

Anna Málle.	Koimbatúr.	(Pálne Hills.)
Átäre Málle.	Koterghérri.	Shevarái.
Dodabétta.	Kunúr.	Sírlu.
(Jakatálla).	Manantvádi.	Utakamánd.
Jakunári.	Mount-Zion.	Wellington.

In comparing the different stations of the *Nílgiris*, it must be kept in view, that in this part of India the temperature varies much less from north to south than from west to east; for the mean of the year and, the cool season excepted, for all the other months of the year, the thermic equator[1] passes to the east of the Nílgiris in a nearly vertical direction. The decrease of temperature[2] with height is here more rapid (quite isolated peaks excepted), and therefore more favourable to the erection of sanitaria than any of the mountainous regions to the south of the Himálaya; and not only the higher parts, but also steps of minor elevation, are topographically well adapted to settlement and colonization. The jángels, even in the lower parts, are neither very dense nor do they cover large tracts; altogether, the Nílgiris are not thickly wooded. Forests, luxurious and extensive in the higher parts, fill but hollows and depressions of the mountain sides. Mists, and even heavy steamy fogs, are not unfrequent in the rainy season; the eastern side is less moist than the western; from the end of October to May a sky clear and nearly cloudless is the rule; September and October are pretty irregular in the quantity of rain they bring.

[1] Compare Meteorological Maps of the Atlas, Nos. II. and III.
[2] Compare the tables given above, p. 139.

Ánna Mállē-Hills.

Latitude North.	Longitude East Green.	Height.
10° 39′	76° 40′	6,800 feet.

1857. Observations during Dr. Cleghorn's visit to the higher regions. Tunukádu, where the Assistant Conservator of Forests has fixed his head-quarters, is about 3,000 feet above the sea.

Mean of the months:

September 66 October 56

The upper ranges of these hills, which attain an elevation equal to that of the Nílgiris in general, are entirely uninhabited. The temperature, says Dr. Pearce, Parl. San. Rep., vol. II., p. 608, is much the same as in Utakamánd. But the rains are very heavy for six months of the year, and it is doubtful whether the climate during these months would be at all suitable for the residence of Europeans.

Átăre Mállē.

Latitude North.	Longitude East Green.	Height.
8° 31′	77° 10′	Ab. 4,500 feet.

1845-6. Sykes. (= Attre Mallē.) Means. Phil. Trans., 1850, p. 324.

Months.	1845	1846	General mean.	Months.	1845	1846	General mean.
	Mean of the month.				Mean of the month.		
January	62·1	63·4	62·7	July	66·0	63·8	64·9
February	64·2	65·8	65·0	August	66·7	64·4	65·5
March	69·6	65·6	67·6	September	67·5	64·9	66·2
April	68·4	67·8	68·1	October	65·6	63·4	64·5
May	67·8	65·3	66·5	November	65·6	63·9	64·7
June	65·1	62·3	63·7	December	63·5	63·2	63·3
				Mean	66·0	64·5	65·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
63·6	67·4	64·7	65·1	65·2

Dodabétta.

Latitude North.	Longitude East Green.	Height.
11° 23′	76° 44′	8,640 feet.

1847-50. Taylor. Published by order of the Madrás Government; 1848 and 1852. 9^h 40 A.M. and 3^h 40 P.M. On account of the very small variation of temperature in these elevated tropical regions, the following temperatures, being the observations at 9^h 40^m, can be considered as differing very little from the daily mean.

January 1847 is interpolated, from the means of 1848-50, to obtain the mean for this year.

Months.	1847	1848	1849	1850	General mean.
	Mean of the month.				
January	(50·8)	51·9	49·9	50·7	50·8
February	52·1	53·2	53·4	50·0	52·2
March	54·4	56·5	55·7	53·8	55·1
April	56·3	56·7	58·0	55·6	56·6
May	57·1	57·8	58·4	57·4	57·7
June	52·1	53·4	53·3	53·0	52·9
July	52·3	52·4	53·3	52·8	52·7
August	52·9	52·4	52·8	53·5	52·9
September	52·0	53·2	51·6	52·0	52·2
October	53·2	53·1	52·2	53·6	53·0
November	52·3	51·5	51·9	51·9	51·9
December	51·1	50·2	50·6	51·4	50·8
Year	53·0	53·5	53·4	53·0	53·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
51·3	56·5	52·8	52·4	53·2

Jakatálla, *see* Wellington.

JAKUNÁRI.

Latitude North.	Longitude East Green.	Height.
11° 24′	76° 53′	Ab. 5000 feet.

1826. MACPHERSON. Means deduced from extremes. Medical and physical Trans., Vol. IV., p. 400.

1826. Mean of the month.					
January	57·1	May	63·5	September	58·3
February	55·2	June	62·0	October	61·8
March	60·8	July	64·3	November	57·1
April	62·9	August	62·5	December	59·7

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
57·3	62·4	62·9	59·1	60·4

KOIMBATÚR.

Latitude North.	Longitude East Green.	Height.
11° 1′	76° 58′	1,483 feet.

1852-4. PORTEOUS. Only means can be given; the hours were not kept very regularly.
SCHLAGINTWEIT, "Met Mscr.," Vol. 7.

Months.	1852	1853	General mean.	Months.	1852	1853	General mean.
	Mean of the month.				Mean of the month.		
January	73·0	74·0	73·5	July	76·0	77·5	76·7
February	73·5	72·0	72·7	August	78·0	76·5	77·2
March	81·0	77·5	79·2	September	78·5	76·5	77·5
April	83·5	80·0	81·7	October	77·5	74·5	76·0
May	83·0	79·0	81·0	November	75·5	73·0	74·2
June	77·5	76·5	77·0	December	74·0	72·5	73·2
				Year	77·6	75·8	76·7

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
73·1	80·6	77·0	75·9	76·7

Isolated months (means). 1854: Febr. 77·5; March 83·5; April 84·0; June 76·0; July 75·0.
(Not included in the mean.)

Koterghérri.

Latitude North.	Longitude East Green.	Height.
11° 26′	76° 57′	6,100 feet.

1847. Ouchterlony, in Baikie's "Neilgherries," 1857. App., p. VI. Means of SR. and 2^h 40^m P.M.

1847. Mean of the month.

January	58·7	July	65·0
February	59·7	August	65·5
March	60·5	September	64
April	62·0	October	62
May	62·2	November	60·5
June	63·5	December	59·0

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
59·1	61·6	64·7	62·2	61·9

Kunúr.

Latitude North.	Longitude East Green.	Height.
11° 21′	76° 45′	5,761 feet.

Macpherson, Madras Sanitaria Reports, 1862, p. 21, year not indicated.

Mean of the months.

January .	60	April . . .	68	July . . .	70	October. .	65
February .	62	May . . .	68	August . .	70	November	62
March . .	68	June . . .	65	September	70	December	62

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
61·3	68·0	68·3	68·0	66·4

MANANTVÅDI.

Latitude North.	Longitude East Green.	Height.
11° 48′	76° 1′	2,685 feet.

1832. MENCHIN. Communicated by the Hon. Walter ELLIOT, of Madras. Daily extremes.

1832. Mean of the month.

January	57	May	72	September	67½
February	63½	June	69	October	67¾
March	70¾	July	67	November	68
April	71½	August	67	December	65¼

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
61·9	71·4	67·7	67·7	67·2

MOUNT-ZION STATION, on the Verrughéri or Pålne (Pulney) Table Land.

Latitude North.	Longitude East Green.	Height.
10° 30′	76° 50′	6,800 feet.

1856. From communications of the Madras Government; the months, except those marked by asterisks, are very incomplete; but the estimates I had made to obtain the means may be considered as sufficiently well defined, the variation of temperature being altogether not very great. Mean of 7^h A.M.; N.; 5^h P.M.

Mean of the months.

January	57	May	64	September	59
February	59*	June	60	October	59
March	62*	July	61	November	58
April	63*	August	60	December	57

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
57·7	63·0	60·3	58·7	59·9

The distance of the important mountainous region of the Pålne Hills is from

Trichinápali about 80 miles, from Mathúra (Madura) about 40. It is one of the plateaux recently proposed as a site for a Sanitarium; but as yet I have no details about the temperature. Its geographical co-ordinates may be defined as follows: Latitude North 10° 10′ to 10° 44′; Longitude East Green. 76° 21′ to 77° 22′; Height 6,500 to 7,100 feet.

SHEVARÁI-HILL-STATION.

Latitude North.	Longitude East Green.	Height.
11° 55′	78° 10′	5,260 feet.

Means from MACPHERSON's Madras Sanitaria Reports, 1862, p. 6 to 11, and p. 21. This Hilly range approaches within 5 miles to Sálem.

Mean of the months.

January	65	May	71	September	67
February	65	June	68	October	66
March	68	July	68	November	66
April	71	August	68	December	65

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·0	70·0	68·0	66·3	67·3

SÍRLU.

Latitude North.	Longitude East Green.	Height.
11° 22′	76° 55′	Ab. 3,500 feet.

1826. MACPHERSON. Means deduced from extremes. Med. and phys. Transactions, Vol. IV., p. 400.

1826. Mean of the month.

January 68·5 February 69·5 March 73·6 May 76·1.

UTAKAMÅND.

Latitude North.	Longitude East Green.	Height.
11° 23′·7	76° 43′·2	7,490 feet.

1826. MACPHERSON. Means deduced from extremes. Medical and physical Transactions. Vol. IV., p. 400.

1829-36, and 1831, 2, 5, 6. BAIKIE. Means deduced from extremes. These and the following years are contained in Dr. BAIKIE's "Neilgherries," edited by SMOULT, Calcutta, 1857. App. He gives, besides these means for the whole period, also values for single months of the different years 1831, 2, 5, and 6. Their being included by him in the mean or not cannot appreciably alter the result.

1847. OUCHTERLONY, in BAIKIE's "Neilgheries." App., p. VI., SR.; 2^h; SS. I took the mean of SR. and 2.

1853-6. ROSS, in BAIKIE, App., p. VII. Mean of extremes.

Months.	1826	1829-36	1831	1832	1835	1836	1847	1853	1854	1855	1856	General mean.
	Means of the month.											
Jan.	50·9	51·8	....	53	....	50·4	52·5	....	53·6	49·7	50·2	51·5
Febr.	52·1	53·8	....	53·5	....	51·9	54·5	....	53·1	51·5	51·9	52·8
March	60·0	57·8	58	58·5	....	56	58·5	....	57·5	53·0	56·1	57·3
April	60·3	59·8	62	63	....	61	61	58·2	60·5	57·2	57·7	60·1
May	62·6	61·6	60·5	64·5	....	61·8	61	60·5	60·0	60·0	55·3	60·8
June	58·1	57·2	59·5	62·5	56·2	....	58·5	57·5	58·5	57·4	53·9	57·9
July	56·7	56·5	58	55	56·6	....	57	54·2	55·0	55·9	54·4	55·8
Aug.	58·1	56·6	59	56·5	56·2	....	57	54·7	55·7	54·7	52·9	56·1
Sept.	56·9	57·1	56·5	57·5	56·8	....	57	56·5	54·9	54·7	....	56·4
Oct.	55·3	57·2	58	....	56·8	....	56·5	54·7	55·7	53·1	....	55·9
Nov.	55·4	53·9	56	....	54·6	....	55	52·1	52·5	51·4	....	53·9
Dec.	52·6	52·3	52·5	....	53·1	....	52·5	51·6	51·5	49·4	....	51·9
Year	56·6	56·3	....	....	....	....	56·7	....	55·7	54·0	....	55·9

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
52·1	59·4	56·6	55·4	55·9

Wellington.

Latitude North.	Longitude East Green.	Height.
11° 23′	76° 46′	5,860 feet.

1859. Sparrow. Max. and Min. Parl. San. Rep., Vol. II., p. 442.

Mean of the months.

January	64	July	68
February	63	August	70
March	67	September	67
April	64	October	69
May	69	November	66
June	68	December	70

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·7	66·6	68·7	67·3	67·1

Another set of temperatures I got communicated for Jakatálla, the native place near Wellington station.

The monthly means, entered separately in the Meteor. Table No. I., are the following:—

Mean of the months.

January	59	April	68	July	70	October	65
February	61	May	68	August	70	November	62
March	67	June	64	September	70	December	62

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
61·3	68·0	68·3	68·0	66·4

GROUP VIII: SOUTHERN INDIA, COASTS, KÓNKAN, MÁLABAR, KARNÁTIK.

Anjarakándi.	Kananúr.	Punamáli.
Árkot.	Karikál.	Rajamándri.
Bombay.	Kóchin.	S. Thomas Mount.
Chittúr.	Madrás.	Sálem.
(Curlew Island.)	Madúra.	Súrat.
Dápuli.	Mangalúr.	Tinevélli.
Dhúlia.	Masulipatám.	Trichinápalli.
Gantúr.	Nellúr.	Trivándrum.
Kádalur.	Pallamkótta.	Vingórla.
Kalikát.	Pondichéri.	

A comparison between the western and eastern coasts of southern India is a description of all the principal features of a littoral and tropical climate: a powerful sun, high annual means, little variation between the different seasons, great moisture and a periodical modification of the heat by sea-breezes. The mean of the year, most distinctly in the period from June to September, is higher along the eastern than along the western coast; from December to March the western coast is warmer, but the difference then is much smaller. On the coast of Bombay a drift along the sea-shore from north to south predominates; in the Bay of Bengál the directions of the currents are more variable.

The general type is the same on both coasts; both climate and vegetation differ essentially from those of Europe, and more constantly than in any part of the interior; the uniformity of type, however, makes a short description sufficient.

Early in December the *cool season* makes itself very decidedly felt in Bombay: 70° Fahr. in the morning is not unfrequent at Bombay and Madrás; but the days are often still oppressive enough; along the western ghāts thunderstorms then add their influence towards breaking the heat. This was not exactly the impression it made upon me, when, in 1854, I passed the first months on a tropical shore in the cool season at Bombay; but subsequently I learnt by experience to appreciate the climate then called there "mild and cool." Even at this season thunderstorms of very short duration, but of all the intensity of tropical violence, take place, and it is surprising for the European to see them followed in a few minutes by the most brilliant sky. In Bombay January is the month most variable. Its variability, however, is still different enough from that of other regions. In 1857, throughout all the year, amongst 307 days of observation there were 200 instances in which the difference between the mean of two consecutive days was less than 1° Fahr.

In February all along the western coast the land-winds become the predominating air-currents; the day is dry and hot; during the night, till shortly after sunrise, the temperature is still cool. With the exception of this period, December to February, the climate is, in consequence of the heat being combined with great moisture, very debilitating. In Madrás dew, even heavy dew, is frequent in December and January; also ground-fogs are formed; they are very low, not rising higher than to 2 to 3 feet above the ground; they do not interfere with the unrivalled aspect of a tropical night of starlight.[1]

The *hot season* on the western coast begins in March, and ends with May; also at this period sea-breezes alternate with the land-winds; but they are much more reduced in duration and intensity in the southern parts; in the beginning of May 1855 Bombay enjoyed, though exceptionally, as fine a sea-breeze from noon till after sunset as in the cool season; but at Kananúr, though also on the Málabar coast, the weather was hot and close. Along the eastern coasts the south-west monsun begins early in May, but the heat continues increasing, less in the extremes than in the mean of the 24 hours, till July. In March and April, as well as in May, the air is frequently rendered damp by a "south," or "long-shore," wind; though it varies but little in temperature, its moisture becomes a regular cause of frequent rheumatic complaints.

[1] I may here add that Mr. Pogson quite recently, February 2nd, 1864, discovered the 80th of the asteroids from the Madrás observatory; he called it Sappho.

The *rainy season* sets in shortly after the beginning of the south-west monsun; on the western coast about the commencement of June; in the interior, to the east of the ghāts, it is generally a little later, but there is no lack of stormy weather preceding it, with severe squalls and occasional showers. It is not unusual that also along the sea-shore a retardation of the monsun for a week or two takes place, as in 1854. On the eastern, or Koromándel, coast the south-west monsun, having lost its moisture during the passage over the Ghāts and the Nílgiris, is not the season of rain, in its beginning. "In June," they say at Madrás, "land-winds, sun, and dust form the chief part of our diet." From July the precipitation of rain increases.

Autumn has still some south-west monsun, succeeded by westerly or variable wind all over the southern part of the peninsula; in October, from about the 15th to 20th, the north-easterly monsuns begin. In the Kónkan the rain has then subsided already more than a month, ending with August; the weather, after some irregular depressions of short duration, begins to be cool, with bracing mornings. For the Koromándel coast this is the proper rainy season, lasting till end of November. The north-easterly monsun is a heavy wind with frequent gales: towards midday light sea-breezes very frequently interrupt the monsun.

In reference to the salubrity of the different military stations in the Presidencies of Madrás and Bombay, the best comparison may be drawn from the careful tables presented to Parliament by the Inspectors-general of the medical department, Dr. PEARSE[1] and Dr. MACPHERSON[2] at Madrás, and Dr. ROOKE at Bombay.[3] Statistical details about Bombay Island were published for 1848-1852 by Dr. A. H. LEITH: "Deaths in Bombay, printed by order of Government at the Bombay Education Society's Press." His tables also include the different native castes.

[1] Principal Inspector-General PEARSE's "Report on the Madrás Stations," Parl. San. Rep., Vol. II., pp. 601 to 621.

[2] "Report by Inspector-General of Hospitals, Dr. MACPHERSON, H. M. Madrás Establishment," ibid., pp. 622 to 660, with a very detailed map of Sanitaria for Southern India; I gave a reduction of it for comparison with Himálayan stations in Meteorol. Table, No. IV.

[3] "Replies to questions on the Sanitary State of the Indian Army by Dr. ROOKE, Principal Inspector-General, Med. Dept., Bombay Presidency, ibid., pp. 911 to 918.

A. Madrás Presidency.[1]

No. 1.

Table of Principal Stations occupied by European Troops, arranged according to their order of Salubrity, calculated on the average of 10 years, from 1847 to 1856-7.

Ratio per 1,000 of Sickness to Strength.		Ratio per 1,000 of Deaths to Strength.		Ratio per 1,000 of Deaths to Strength, excluding those from Cholera.	
1 Wellington (3)	1,001	1 Jálna	10·3	1 Jálna	9·3
Bangalúr	1,417	Kannúr	17·9	Bellári	13·2
Kannúr (Kannanur)	1,514	Bellári	18·0	Bangalúr	15·4
Tónghu (5)	1,534	Bangalúr	19·0	Trichinápaly	17·4
5 Rangún (5)	1,630	5 Trichinápaly	19·7	5 Kannúr	17·7
Bellári	1,761	Sikanderabád	24·5	Sikanderabád	24·0
Saint Thomas Mount	1,761	Kámpti	28·6	Kampti	25·1
Trichinápaly	1,814	Madrás	29·6	Madrás	27·1
Sikanderabád	1,825	Wellington (3)	34·1	Wellington (3)	31·2
10 Madrás	1,834	10 Saint Thomas Mount	38·6	10 Rangún (5)	35·1
Kámpti	2,015	Tónghu (5)	42·8	Saint Thomas Mount	37·3
Jálna	2,368	Rangún (5)	48·2	Tónghu (5)	40·7

(The numbers in parentheses indicate the number of years for which the average was obtained where not fully 10 years.)

In the year 1862[2] the Ratio per 1000 of Deaths to Strength was but 25·68, one-third less than in the year preceeding; for the ten years compared in this table the mean is 27·62. In Bombay the ratio was for 1862 24·60, in Bengál 27·55.

[1] Compare the details for Bengál, p. 191.

[2] Quarterly Review, CXVI., p. 432, Oct. 1864.

No. 2.

Table of Stations occupied by Native Troops, arranged according to their order of Salubrity, calculated on the average of 10 years, from 1847 to 1856-7.

Ratio per 1,000 of Sickness to Strength.		Ratio per 1,000 of Deaths to Strength.		Ratio per 1,000 of Deaths to Strength, excluding those from Cholera.	
1 Malákka	374	1 Khilón (Quilon)	6·8	1 Hărrihăr	4·9
Kărnúl	547	Jálna	7·3	Vellúr	5·6
Kannúr	598	Bellári	7·8	Bellári	6·1
Kámpti	611	Kannúr	8·4	Jálna	6·4
5 Penáng	647	5 Sikanderabád	8·5	5 Khilón (Quilon)	6·5
Mangalúr	650	Palghát	9·1	French Rocks	7·01
Vellúr	660	Hărrihăr	9·6	Sikanderabád	7·1
Samalkótta	693	Bangalúr	10·1	Madrás	7·2
Jálna	727	Mangalúr	10·2	Palghát	7·6
10 Hărrihăr	748	10 Masulipatám	10·2	10 Kădapa	7·6
Bellári	772	Vellúr	10·4	Trichinápally	7·8
Sikanderabád	772	Madrás	10·5	Kărnúl	8·0
Palamkótta	774	Kărnúl	10·5	Kannúr	8·4
Khilón (Quilón)	787	Malákka	10·8	Palamkótta	8·6
15 French Rocks	787	15 French Rocks	11·6	15 Malákka	8·7
Madrás	807	Kámpti	11·9	Bangalúr	9·1
Bĕrhampur	824	Kădapa	12·04	Kámpti	9·7
Kădapa	837	Samalkótta	12·2	Masulipatám	9·8
Palghát	839	Merkára	14·4	Mangalúr	10·2
20 Trichinápali	858	20 Palamkótta	15·9	20 Merkára	10·9
Bangalúr	900	Trichinápaly	16·1	Samalkótta	11·3
Vizianágram	966	Vizagapatám	16·3	Bĕrhampur	13·5
Masulipatám	972	Penáng	17·2	Medáy (1)	15·1
Merckára	985	Singapúr	17·3	Vizagapatám	16·1
25 Singapúr	1,035	25 Rangún (4)	17·7	25 Vizianágram	16·8
Rangún (4)	1,358	Medáy (1)	19·6	Singapúr	17·1
Vizapatám	1,383	Vizianágram	19·8	Penáng	17·2
Mulmén	1,512	Bĕrhampur	20·2	Rangún (4)	17·6
Tónghu (4)	1,831	Tónghu (4)	21·9	Tónghu (4)	19·5
30 Henzáda (2)	1,996	30 Mulmén	22·8	30 Mulmén	20·8
Medáy (1)	2,504	Labuán	29·1	Labuán	29·1
32 Labuán (8)	2,714	32 Henzáda	29·2	32 Henzada	29·2

(The numbers in parentheses indicate the number of years for which the average was obtained where not fully 10 years.)

B. Bombay Presidency.

Stations.	Ratio per 1,000 of Sickness to Strength.	Ratio per 1,000 of Deaths to Strength.	Number of Years referred to.
Assirghâr	1,527	13·5	3 years, 1858-61.
Kírki	1,663	13·7	10 „ 1850-60.
Aden	1,386	16·7	10 „ „
Púna	1,842	17·3	10 „ „
Belgâu	1,443	17·8	10 „ „
Sattára	1,808	18·9	3 „ 1857-60.
Dísa	1,854	19·5	10 „ 1850-60.
Ahmedabád	2,088	20·8	3 „ 1857-60.
Shólapur	2,454	20·9	10 „ 1850-60.
Ahmednâggăr . . .	2,377	27·2	10 „ „
Kărráchi	1,856	27·4	10 „ „
Mhau	2,333	28·4	3 „ 1857-60.
Haiderabád	2,306	28·7	10 „ 1850-60.
Nímăch	2,790	30·3	3 „ 1857-60.
Kolába (Bombay) .	1,775	32·0	10 „ 1850-60.
Năssirabád	2,158	37·8	10 „ „
Baróda	2,607	42·3	3 „ 1857-60.
Súrat	4,034	51·7	3 „ „

The *absolute extremes* vary so little that here they are the same nearly every year. In the following table those of Bombay are selected from the Bombay observatory tables for 1855; those for Madrás, Arcot, and Trichinápali from Balfour's "Barometrical Sections," p. 31.

For the *insolation* along these coasts I had no sufficient data for presenting monthly means. Isolated observations made during our travels shall be given with the experimental details in Vol. V. The Bombay observations in Vol. I., for the year 1841, mention "a thermometer exposed to the sun's rays;" but as the late Dr. Buist informed me, it was afterwards given up, the instrument not being delicate enough; it has not been replaced since in the annual registers.

End of May and beginning of June readings from 135° to 140° Fahr. are not unusual.

Absolute Extremes.

Months.	Bombay.		Madrás.		Árkot.		Trichinápalli.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
January	60·0	88·2	67	83	65	81	71	81
February	68·8	87·2	68	87	66	84	72	85
March	67·2	93·3	69	90	63	92	79	92
April	74·0	93·2	75	92	82	93	84	96
May	79·3	94·2	78	100	75	95	82	97
June	76·0	95·3	79	98	82	95	82	96
July	75·8	89·4	77	95	82	93	83	95
August	74·4	89·2	76	94	78	93	83	90
September	75·0	88·3	75	93	79	89	79	90
October	73·0	92·5	74	92	73	89	75	85
November	71·6	91·5	71	86	73	83	72	86
December	66·2	90·8	70	84	69	78	73	85

(Views from the coasts of southern India will be given in that part of the Atlas accompanying Vol. V.)

Anjarakándi, in Málabar.

Latitude North. 11° 40′ — Longitude East Green. 75° 40 — Height. L. a. L. S.

1810-13, 1818-23. Means from observations by Browne, Trans. Literary Soc. of Madrás, 1827, p. 89.

Months.	1810	1811	1812	1813	1818	1819	1820	1821	1822	1823	General mean.
	Mean of the month.										
January	78	78	79	80	79	$78\frac{1}{3}$	80	82	82	$80\frac{2}{3}$	79·7
February	82	$83\frac{2}{3}$	$80\frac{1}{3}$	81	81	81	83	$81\frac{1}{3}$	$82\frac{2}{3}$	83	81·9
March	$81\frac{2}{3}$	$83\frac{2}{3}$	84	85	84	83	$84\frac{1}{3}$	$83\frac{1}{3}$	85	84	83·5
April	84	$84\frac{2}{3}$	85	85	$85\frac{1}{3}$	86	$84\frac{1}{3}$	87	$86\frac{1}{3}$	88	85·6
May	82	84	$83\frac{2}{3}$	80	$83\frac{2}{3}$	85	82	85	$85\frac{1}{3}$	$86\frac{1}{3}$	83·7
June	78	79	$78\frac{2}{3}$	$79\frac{2}{3}$	80	$80\frac{1}{3}$	78	$83\frac{1}{3}$	$80\frac{1}{3}$	$80\frac{2}{3}$	79·8
July	77	80	$78\frac{2}{3}$	79	78	79	$77\frac{2}{3}$	79	79	77	78·4
August	$78\frac{2}{3}$	$79\frac{2}{3}$	79	79	$77\frac{1}{3}$	$79\frac{2}{3}$	$78\frac{1}{3}$	$79\frac{1}{3}$	79	$79\frac{2}{3}$	79·1
September	79	$80\frac{2}{3}$	$77\frac{2}{3}$	$78\frac{2}{3}$	$80\frac{2}{3}$	79	$79\frac{1}{3}$	$81\frac{2}{3}$	$79\frac{1}{3}$	$80\frac{1}{3}$	79·6
October	$80\frac{2}{3}$	$80\frac{2}{3}$	$80\frac{2}{3}$	78	$80\frac{2}{3}$	80	$81\frac{1}{3}$	$82\frac{2}{3}$	$80\frac{1}{3}$	$82\frac{1}{3}$	80·7
November	81	$77\frac{2}{3}$	$79\frac{2}{3}$	80	82	80	$81\frac{2}{3}$	$81\frac{2}{3}$	81	$81\frac{2}{3}$	80·6
December	80	79	$79\frac{2}{3}$	79	$79\frac{1}{2}$	81	$81\frac{1}{3}$	$81\frac{1}{3}$	$80\frac{2}{3}$	$80\frac{1}{3}$	80·2
Year	80·2	80·9	80·5	80·3	80·9	81·0	80·9	82·3	81·7	82·0	81·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
80·6	84·3	79·1	80·3	81·1

Árkot, in the Kárnatik.

Latitude North. 12° 54′·3 — Longitude East Green. 79° 19′·0♁ — Height. 599 feet.

1830 and 1831. 18 months; from Balfour's "Barometrical Sections," p. 31.

1830 and 1831. Mean of the month.											
Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
74	76	82	87	85	88	87	85	83	81	78	73

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
74·3	84·6	86·6	80·6	81·5

BOMBAY, in the Kónkan, Kolába observatory.

Latitude North.	Longitude East Green.	Height.
18° 53′·5	72° 49′·1 ♁	38 feet.

1827. ADIE. SR.; 11; 1; 4; 9. Edinb. Journ. of Sc., Vol. 10.

1842-57. Hourly observations in "Magnetical and Meteorological Observations at the Bombay Observatory," published annually. — Observers: BUIST, ORLEBAR, MONTRIOU, FERGUSSON. For 1842 to 1844 I took the mean of 6^h and 4^h for the daily period; for the other years the values are based upon the mean of the 24 single hours.

Compare also NICHOLL's "Remarks upon the Temperature of Bombay," Transact. As. Soc. Bomb., Vol. I., p. 4; and "Mean annual temperature of the Hills and at Bombay," 1838. Ind. Journ. Med. Soc., Vol. III., p. 397.

Months.	1827	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	General mean.
Jan.	74·95	....	76·3	75·4	.....	76·86	75·2	75·5	73·3	72·4	72·2	71·9	71·6	75·8	74·7	76·4	74·7	74·5
Febr.	78·97	....	78·0	73·3	.....	77·79	73·7	75·1	75·8	75·1	75·5	75·8	76·4	75·0	77·0	77·1	77·7	76·2
March	79·98	....	79·7	79·5	.....	79·85	79·4	78·7	79·2	79·3	79·8	80·1	81·6	80·3	79·2	81·5	81·8	80·0
April	83·53	....	84·2	84·1	83·67	83·78	82·1	83·1	82·1	82·0	83·3	83·2	83·5	84·0	82·0	84·7	83·1	83·3
May	86·30	....	85·9	85·9	85·93	85·02	83·9	84·6	85·2	84·4	84·7	86·3	86·9	86·9	86·0	86·1	86·1	85·6
June	83·35	....	85·3	85·3	84·33	82·94	81·0	81·5	81·3	83·8	82·5	83·9	84·0	84·2	83·8	83·0	83·4	83·3
July	82·86	....	82·0	81·9	82·75	80·33	80·4	81·1	80·1	81·7	80·1	82·0	80·5	80·4	82·0	81·0	82·1	81·3
Aug.	80·45	....	81·2	81·6	81·34	80·56	79·8	80·2	80·1	81·0	79·9	80·4	80·8	81·4	82·1	80·6	79·3	80·7
Sept.	80·86	81·6	81·1	80·7	81·66	79·86	78·9	81·0	78·8	80·7	80·4	80·6	80·7	80·9	81·0	80·1	79·0	80·4
Oct.	83·53	82·9	82·2	83·5	83·85	80·42	82·1	80·9	81·2	83·0	81·6	82·1	82·0	81·7	82·6	80·9	80·5	82·1
Nov.	81·78	81·5	80·3	80·8	80·38	77·62	75·9	79·3	81·3	79·3	79·5	80·2	80·6	79·8	80·6	79·0	77·4	79·7
Dec.	75·23	79·3	76·7	79·6	77·47	75·72	75·7	76·6	76·5	75·8	75·0	75·7	76·9	77·3	77·7	75·0	73·9	76·5
Year	81·0	....	81·1	81·2	.....	80·1	79·0	79·8	79·6	79·9	79·5	80·2	80·5	80·6	80·7	80·7	79·9	80·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·7	83·0	81·8	80·7	80·3

CURLEW ISLAND, OR KALLGÚK.

On the proposal of Dr. MACPHERSON, of Madrás, and Capt. FRASER, engineer of the Alguáda Light-house, government has sanctioned the making this island a marine sanitarium and watering-place. The news reached me in April 1862, but I have not yet received further details, although Dr. MACPHERSON kindly supplied me with information as to the meteorological observations made at many other stations.

CHITTÚR, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
13° 11′	79° 6′	1,112 feet.

1853 and 1854. HARPER. SR.; 10; 2; 4; 10. For 1853 only the mean of the month, deduced from SR. and 4^h, was communicated to me.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 8.

Months.	1853 Mean of the month.	1854 SR.	1854 4^h P.M.	1854 Mean of the month.	General mean.	Months.	1853 Mean of the month.	1854 SR.	1854 4^h P.M.	1854 Mean of the month.	General mean.
January	77·2	68·5	79·5	74·0	75·6	July	87	78·7	86·7	82·7	84·8
February	77·7	72·2	83·7	77·9	77·8	August	84	78·5	86·0	82·2	83·1
March	82·4	77·2	87·0	82·1	82·2	September	85·5	78·0	85·0	81·5	83·0
April	85·8	84·5	97·7	91·1	88·4	October	80·7	72·7	80·2	76·4	78·5
May	90·5	86·0	93·0	89·5	90·0	November	76·0	67·0	77·0	72·0	74·0
June	87·7	82·7	89·5	86·1	86·9	December	(75·0)	....	....	72·5	73·7
						Year	82·5			80·7	81·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·7	86·9	84·9	78·5	81·5

DÁPULI, in the Kónkan.

Latitude North.	Longitude East Green.	Height.
17° 48′	73° 13′	600 feet.

1859. JOHNSTONE. SR.; 10; 4; 10. The values given below are the means of these 4 hours; the maxima and minima were taken by registering instruments. Parl. San. Rep., Vol. II., p. 883.[1]

1859.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	61·3	87·5	74·8	July	74·2	83·9	81·0
February	62·5	89·6	77·7	August	72·9	78·3	78·5
March	68·1	91·1	79·9	September	72·7	83·4	77·4
April	73·8	93·6	84·4	October	69·6	88·6	78·9
May	75·2	92·0	84·2	November	68·1	92·8	79·7
June	75·1	85·6	79·9	December	61·2	(broken)	73·7

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·4	82·8	79·8	78·7	79·2

[1] For June the mean there is 89·9 instead of 79·9.

Dhúlia, in Kandésh.

Latitude North.	Longitude East Green.	Height.
24° 54′	74° 42	1,000 feet.[1]

Sept. 1853 to March 1858. Greig, Capt. Engineers. Means, without the details being given; but they appear to be carefully combined when compared with the extremes. Parl. San. Rep., Vol. II., p. 892.

1853 to 1858.					
January	70·4	May	91·3	September	80·0
February	75·5	June	87·3	October	80·0
March	82·5	July	81·7	November	75·9
April	87·9	August	79·9	December	71·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·6	87·3	83·0	78·6	80·4

[1] The height of the mountain Torum Mal, in its vicinity, is at the lake 4,304 feet, on the summit 5434.

GANTÚR, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
16° 17′·7	80° 25′·6ꝺ	L.a.L.S.

1852-3. J. FLETCHER. Only approximate monthly means.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 9.

1855-9. Extremes and "Means." Parl. San. Rep., Vol. II., p. 459. I left it out, however, since I did not know how to interpret or to combine the data. I allude to the circumstance that the "mean temperature" in July is 1° Fahr. warmer than the "mean maximum." Again, in November it is 10° Fahr., in December 5° Fahr., cooler than the "mean minimum."

1852-3. Monthly Means.							
January	74½	April	84½	July	84	October	82
February	78½	May	88	August	83½	November	81
March	81½	June	85½	September	82½	December	78½

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
77·2	84·7	84·3	81·8	82·0

Kádalur, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
11° 43′·6	79° 45′·7 ♁	L. a. L. S.

1853-4. Burnell. 1853: SR.; 10; 2; SS. — SR.; 10; 2; 4; 10. — To obtain the mean I adopted, for 1853: $4 = \frac{2 + \text{SS.}}{2}$, which gave differences between SR. and 4^h quite in analogy with the direct observations in 1854.

Schlagintweit, "Met. Mscr.," Vol. 7.

Months.	1853 SR.	1853 4^h P.M.	1853 Mean of the month.	1854 SR.	1854 4^h P.M.	1854 Mean of the month.	General mean.
January	80	81·2	80·6	74	74·5	74·2	77·4
February	80·5	81·0	80·7	76·5	79·0	77·7	79·2
March	84	85·0	84·5	80·5	84·0	82·2	83·3
April	84	85·7	84·8	84·0	86·0	85·0	84·9
May	86	89·5	87·7	85·5	88·5	87·0	87·3
June	85	89·7	87·3	84·0	86·0	85·0	86·1
July	85·5	88·5	87·0	84·5	85·5	85·0	86·0
August	82·5	85·0	83·7	84·5	84·0	84·2	83·9
September	83·5	85·5	84·5	84·0	85·0	84·5	84·5
October	81·5	83·5	82·5	83·5	83·0	83·2	82·8
November	75·5	79·5	77·5	78·0	80·0	79·0	78·2
December	74·5	76·9	75·7	....	....	(77·0)	76·3
Year	Mean for 1853: 83·0			Mean for 1854: 82·0			82·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
77·6	85·2	85·3	81·8	82·5

KALIKÁT, in Málabar.

Latitude North.	Longitude East Green.	Height.
11° 15′·2	75° 45′·4 ठ	L. a. L. S.

1853-4. DAVIDS; BARKER. SR., 10; 4; SS. and SR.; 10; 2; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 3.

Months.	1853 SR.	1853 4h P.M.	1853 Mean of the month.	1854 SR.	1854 4h P.M.	1854 Mean of the month.	General mean.
January	81·0	83·2	82·1	77·7	83·5	80·6	81·3
February	81·0	84·2	82·6	79·7	84·0	81·8	82·2
March	83·7	86·5	85·1	81·2	84·2	82·7	83·9
April	84·2	87·0	85·6	84·7	83·5	84·1	84·8
May	85·2	87·5	86·3	83·0	86·7	84·8	85·5
June	80·0	80·7	80·3	77·5	81·9	79·7	80·0
July	78·7	80·0	79·3	76·7	79·5	78·1	78·7
August	78·7	80·0	79·3	78·2	81·0	79·6	79·4
September	79·7	82·0	80·8	77·5	79·0	78·2	79·5
October	80·0	83·2	81·6	77·5	80·7	79·1	80·3
November	79·7	83·0	81·3	77·5	82·0	79·5	80·4
December	76·7	82·0	79·3	76·5	82·0	79·2	79·2
Year	Mean for 1853: 81·9			Mean for 1854: 80·6			81·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
80·9	84·7	79·4	80·1	81·3

Kananúr, in Málabar.

Latitude North.	Longitude East Green.	Height.
11° 51′·4	75° 21′·3 ♁	L. a. L. S.

1852-4. White; Davids. 1852-3: SR.; 10; 4; SS.—1854: SR.; 10; 2; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 7.

1850-8. "Mean temperature," without the details of the hours employed. It is throughout about 1° Fahr. warmer, probably an evening hour (SS.?), being included. Parl San. Rep., Vol. II., p. 405.

Months.	1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	76	86	81·0	75	84	79·5	73	84	78·5	79·7
February	77	88	82·5	76	85	80·5	75	85	80·0	81·0
March	80	89	84·5	80	87	83·5	79	87	83·0	83·7
April	83	91	87·0	81	88	84·5	82	85	83·5	85·0
May	80	87	83·5	82	88	85·0	81	89	85·0	84·5
June	79	83	81·0	77	79	78·0	78	81	79·5	79·5
July	78	82	80·0	76	79	77·5	76	79	77·5	78·3
August	77	82	79·5	76	80	78·0	77	81	79·0	78·8
September	78	82	80·0	77	81	79·0	77	81	79·0	79·3
October	78	83	80·5	77	83	80·0	76	81	78·5	79·7
November	77	85	81·0	77	84	80·5	77	84	80·5	80·7
December	76	83	79·5	72	84	78·0	76	84	80·0	79·2
Year	Mean for 1852: 81·7			Mean for 1853: 80·3			Mean for 1854: 80·3			80·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May	June to Aug.	Sept. to Nov.	Year
80·0	84·4	78·9	79·9	80·8

Karikál, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
11° 5′	79° 56′	L.a.L.S.

1854-6. I obtained it from Dr. Godineau. $1/2^h$ before SR.; 2; 9.

Schlagintweit, "Met. Mscr.," Vol. 7.

For deducing the daily mean I adopted, from analogy with the Madras observations, $4 = 2 - \frac{2-9}{3}$

Months.	1854			1855			1856			General mean.
	$1/2^h$ before SR.	4^h P.M.	Mean of the month.	$1/2^h$ before SR.	4^h P.M.	Mean of the month.	$1/2^h$ before SR.	4^h P.M.	Mean of the month.	
Jan.	73·8	78·9	76·3	75·2	78·5	76·8	73·4	80·2	76·8	76·6
Febr.	77·4	82·7	80·0	74·2	79·7	76·9	74·2	85·9	80·0	79·0
March	81·2	85·1	83·1	79·4	81·9	80·6	77·4	87·5	82·4	82·0
April	84·2	90·6	87·4	84·6	85·3	84·9	83·0	90·3	86·6	86·3
May	85·3	93·1	89·2	86·0	88·1	87·0	82·1	89·4	85·7	87·3
June	87·5	96·3	91·9	84·1	85·1	84·6	84·2	95·1	89·6	88·7
July	82·6	91·1	86·8	82·8	84·4	83·6	80·1	92·6	86·3	85·6
Aug.	81·6	90·7	86·1	79·9	82·7	81·3	79·0	87·3	83·1	83·5
Sept.	81·6	90·2	85·9	81·7	83·6	82·6	78·7	89·1	83·9	84·1
Oct.	82·4	86·7	84·5	79·0	80·1	79·5	77·8	86·2	82·0	82·0
Nov.	78·3	81·9	80·1	76·1	78·3	77·2	76·7	81·9	79·3	78·9
Dec.	74·9	79·8	77·3	72·5	74·3	73·4	72·9	76·5	74·7	75·1
Year	Mean for 1854: 84·0			Mean for 1855: 80·7			Mean for 1856: 82·5			82·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May	June to Aug.	Sept. to Nov.	Year
76·9	85·2	85·9	81·7	82·4

Kóchin, in Málabar.

Latitude North.	Longitude East Green.	Height.
9° 58′·1	76° 13′·6 ♁	L.a.L.S.

1852-4. Barker. SR.; 10; 4; SS. and SR., 10; 2; 4; 10.

Schlagintweit, "Met. Mscr.," Vol. 3.

Months.	1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	73·9	83·3	78·6	75·0	84·9	79·9	74·0	85·3	79·6	79·4
Febr.	75·3	85·1	80·2	74·5	84·9	79·7	76·8	87·5	82·1	80·7
March	79·3	87·3	83·3	79·0	86·6	82·8	80·9	88·5	84·7	83·6
April	80·2	88·5	84·3	79·7	88·1	83·6	82·1	90·1	86·1	84·7
May	77·7	84·7	81·2	79·1	87·2	83·1	80·3	87·8	84·0	82·7
June	76·8	81·0	78·9	76·9	80·7	78·8	73·4	80·6	77·0	78·2
July	77·0	80·5	78·7	76·5	80·4	78·4	77·8	80·4	74·1	77·1
Aug.	76·6	81·0	78·8	77·0	80·0	78·5	79·2	81·0	80·1	79·1
Sept.	77·4	82·4	79·9	77·1	83·4	80·2	79·0	81·3	80·1	80·1
Oct.	76·7	83·7	80·2	76·7	83·2	79·9	79·4	81·2	80·3	80·1
Nov.	76·7	85·9	81·3	78·0	81·3	79·6	79·3	81·2	80·2	80·3
Dec.	75·9	83·2	79·5	75·0	84·4	79·7	78·2	82·3	80·2	79·8
Year	Mean for 1852: 80·4			Mean for 1853: 80·3			Mean for 1854: 80·7			80·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May	June to Aug.	Sept. to Nov.	Year
80·0	83·7	78·1	80·2	80·5

Madrás, in the Karnátik;

Astronomical and Magnetical Observatory.

Latitude North.	Longitude East Green.	Height.
13° 4′·2	80° 13′·9 ♉	27 feet.

For Madras we have three series of observations:

a) 1796-1821. This series has been reduced by Goldingham to true means by comparison with the results of hourly observations.

b) 1822-43. Observations by Goldingham and Taylor, published under the title: "Meteorological Register," Madrás, fol.

The hours of observation were, during this series, from 1822-37: SR.; 10; 12; 2; SS.; from 1837-43: 10; 4; 10. The hourly observations of the period 1841-50 allowed one to deduce true means, and I found that, for Madrás, from the observations at 10 o'clock A. M. 2° Fahr. had to be deducted to obtain, with very small deviation, the *true means*. Besides, Dove had observed already, Berl. Acad., 1847, p. 30, that the instrument in use till October 1830, then broken by a typhoon, had to be corrected—1° 7′ Fahr. He obtained this result by direct comparison of the observations of each year with the mean of the entire period. To my monthly means for this period this instrumental correction is applied.

c) From 1841-50 hourly observations were made most carefully under the superintendance of Taylor, Worster, and Jacob. They are printed under the title: "Meteorological Observations at the Magnetical Observatory," Madrás, 1854, 4to. Since this publication, which concludes with the observations of 1850, no new volume has appeared. The thermometer, when examined in 1854, I found to differ from the Kew standard + 1°·0 Fahr. for temperatures between 76° and 95° Fahr., and +0°·9 in those above and below these limits. In the printed volume no corrections are applied. I could not decide whether this had been the case already during all the observations which do not materially differ from the period preceeding, or not. I left them uncorrected, except the last year, 1850, the more as in the mean of the 60 years these four years would not make a difference of even one-tenth. I mention it, however, in order to its being kept in mind in case these years in particular had to be compared with contemporaneous observations of other stations. (Also above, in the hourly variation of temperature in the daily period for which I had to take the year 1850, the correction [—1°·0 Fahr.] is applied.)

d) During our stay in India we obtained copies of the magnetic and meteorogical original observations, made every hour, through the kindness of the Hon. Walter Elliot, the member of council so well known for his scientific activity.

For this series, at first thermometer No. 42, then No. 7, was used; to both the corrections resulting from comparisons with the Kew standard have been applied.

Schlagintweit, "Met. Mscr.," Vol. 8.

Colonel Jacob and Major Worster most kindly supplied us, besides, during the entire period of our travels, with corresponding observations on the temperature of the ground at various depths, with long geothermometers we had left at Madrás.

Of late the Journal of the Madrás Literary Society has also regularly given the details of the meteorological observations made at the Madrás observatory.

(Compare the Station "Saint Thomas Mount.")

I. Series.

1796-1821. Mean of the months.							
January	75·2	April	82·4	July	85·6	October	81·9
February	77·2	May	86·9	August	84·7	November	78·6
March	79·9	June	88·2	September	83·8	December	75·8

II. Series.

1822-43. Mean of the months.							
January	76·2	April	84·7	July	84·7	October	81·6
February	78·0	May	87·6	August	83·4	November	78·0
March	81·6	June	87·0	September	83·4	December	76·4

III. Series.

1841-50 and 55-57. Mean of the months.														
Months.	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1855	1856	1857	General mean.
January	....	77·0	77·6	75·7	76·8	75·7	75·8	74·8	77·2	76·2	....	76·8	75·3	76·3
February	....	77·9	77·9	77·7	79·4	78·9	79·3	78·1	78·6	77·0	....	79·6	75·4	78·2
March	82·0	82·6	81·5	82·2	83·1	82·3	81·5	81·9	81·9	79·8	....	81·7	80·2	81·7
April	84·9	85·7	85·2	86·3	86·6	85·8	86·3	86·4	86·2	85·0	85·3	85·5	84·7	85·7
May	86·8	88·1	85·0	87·0	88·6	87·3	87·6	88·8	90·3	87·3	90·3	85·3	....	87·0
June	86·3	88·0	85·5	88·6	86·6	88·1	85·7	90·4	87·9	87·9	88·8	87·7	....	87·6
July	86·8	86·7	85·8	85·8	86·1	85·1	84·8	87·3	86·4	87·0	88·2	85·6	....	86·5
August	82·5	84·5	84·5	85·2	85·9	84·9	84·5	86·3	86·3	85·5	87·0	82·9	....	85·0
September	83·9	82·4	84·3	83·0	83·9	85·6	84·5	85·0	86·3	83·8	85·3	84·3	....	84·3
October	79·8	81·9	80·7	80·5	82·9	81·9	81·4	82·8	83·1	82·8	81·0	81·2	....	81·6
November	78·3	78·3	77·8	79·2	79·1	78·5	78·6	78·8	80·8	78·0	78·1	77·1	....	78·6
December	76·7	76·6	75·9	76·9	77·7	76·6	76·3	77·3	77·7	76·2	76·2	76·2	....	76·6
Year	....	82·4	81·9	82·3	83·1	82·6	82·2	83·2	83·6	82·2	....	82·0	....	82·4

General mean of the seasons and the year.

Dec. to Febr.	March to May	June to Aug.	Sept. to Nov.	Year
77·0	84·8	86·3	81·5	82·4

General means for the Period of 60 years:

A. Months:

January	75·9	April	84·3	July	85·6	October	81·7
February	77·8	May	87·2	August	84·4	November	78·4
March	81·1	June	87·6	September	83·9	December	76·3

B. Seasons and Year.

Dec. to Febr.	March to May	June to Aug.	Sept. to Nov.	Year
76·7	84·2	85·9	81·3	82·0

Madúra (Mathúra), in the Karnátik.

Latitude North.	Longitude East Green.	Height.
9° 55′·3	78° 6′·3 ~~5~~	600 feet.

1853-4. Colebrook. SR.; 10; 4; SS. and 10; 2; 4; SR.; 10.

Schlagintweit, "Met. Mscr.," Vol. 3.

Months.	1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	77·6	79·7	78·6	78·7	81·6	80·1	79·3
February	78·6	81·6	80·1	83·3	86·8	85·0	82·5
March	83·0	86·6	84·3	85·6	90·7	88·1	86·2
April	85·7	88·7	87·2	87·7	92·7	90·2	88·7
May	86·7	90·7	88·7	88·6	94·1	91·3	90·0
June	84·7	88·6	86·6	88·7	92·6	90·6	88·6
July	84·7	88·6	86·6	85·7	90·1	87·9	87·2
August	83·7	87·2	85·4	85·6	88·7	87·1	86·2
September	85·2	86·7	85·9	85·8	90·0	87·9	86·9
October	82·7	86·7	84·7	83·6	85·8	84·7	84·7
November	78·6	80·7	79·6	79·5	81·8	80·6	80·1
December	77·6	80·7	79·1	77·6	80·6	79·1	79·1
Year	Mean for 1853: 83·9			Mean for 1854: 86·0			84·9

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
80·3	88·3	87·3	83·9	84·9

MANGALÚR.

Latitude North.	Longitude East Green.	Height.
12° 51′·7	74° 49′·2 ♁	L.a.L.S.

1852-4. FONLIS; FALLAN; CHIMMO. SR.; 10; 4; SS. and SR.; 10; 2; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 3.

Months.	1852			1853			1854			General mean.
	S. R.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	76·2	83·8	80·0	77·0	83·5	80·2	75·7	85·0	80·3	80·2
February	73·5	85·1	79·3	78·0	85·5	81·7	76·3	84·7	80·5	80·5
March	79·7	86·0	82·8	81·3	86·8	84·0	82·0	86·3	84·1	83·6
April	82·4	87·2	84·8	81·4	86·6	84·0	84·8	88·3	86·5	85·1
May	82·3	86·0	84·1	83·0	88·1	85·5	84·0	93·5	88·7	86·1
June	79·0	82·8	80·9	77·4	80·7	79·0	75·6	79·5	77·5	79·1
July	77·7	80·0	78·8	77·0	80·2	78·6	76·5	78·7	77·6	78·3
August	77·2	79·2	78·2	77·5	80·7	79·1	72·2	80·7	76·4	77·9
September	77·3	79·9	78·6	78·1	81·7	79·9	77·5	81·5	79·5	79·3
October	77·1	81·2	79·1	78·0	83·7	80·8	77·0	82·7	79·8	79·9
November	76·5	83·9	80·2	78·4	85·5	81·9	77·5	84·2	80·8	81·0
December	76·8	83·5	80·1	76·4	87·6	82·0	76·7	84·2	80·4	80·8
Year	for 1852: 80·6			for 1853: 81·4			for 1854: 81·0			81·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
80·5	84·9	78·4	80·1	81·0

MASULIPATÁM, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
16° 9′·0	81° 8′·2	L. a. L. S.

1854. CRAWFORD. SR.; 10; 2; 4; 10. SCHLAGINTWEIT, "Met. Mscr.," Vol. 9.

Parts of November and December had to be determined approximatively to complete the means.

1854							
Months.	S.R.	4h P.M.	Mean of the month.	Months.	SR.	4h P.M.	Mean of the month.
January	76·4	80·1	78·2	July	81·5	86·5	84·0
February	76·6	82·4	79·5	August	84·7	89·5	87·1
March	79·5	86·5	83·0	September	81·5	84·5	83·0
April	85·0	90·3	87·6	October	80·4	83·3	81·8
May	87·5	93·3	90·4	November	....	....	79½
June	89·3	95·9	92·6	December	....	....	78½

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
78·7	87·0	87·9	81·4	83·8

NELLÚR, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
14° 28′·0	79° 58′·3ȯ	81 feet.

1853-4. Name illegible. SR.; 10; 4; SS. SCHLAGINTWEIT, "Met. Mscr.," Vol. 8.

Months.	1853			1854			General mean.	Months.	1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.			SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
Jan.	77·0	82·6	79·8	69·5	79·7	74·6	77·2	July	84·3	92·3	88·3	83·2	89·9	86·5	87·4
Febr.	73·4	82·1	77·7	72·1	79·6	75·8	76·7	Aug.	81·8	87·4	84·6	83·4	92·9	88·1	86·3
March	70·4	84·3	77·3	75·0	80·6	77·8	77·5	Sept.	83·7	83·4	83·5	82·3	90·1	86·2	84·8
April	81·7	86·5	84·1	80·5	88·3	84·4	84·2	Oct.	80·5	82·1	81·3	80·0	84·3	82·1	81·7
May	85·4	91·8	88·6	82·5	95·4	88·9	88·7	Nov.	75·5	81·0	78·2	72·5	82·9	77·7	77·9
June	84·7	93·0	88·8	85·5	93·7	89·6	89·2	Dec.	69·3	72·8	71·0	....	....	76·0	73·5
								Year	for 1853: 81·9			for 1854: 82·3			82·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·8	83·5	87·6	81·5	82·1

Pallamkóttah, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
8° 43′·5	77° 43′·3 ♉	209 feet.

1853-4. Colebrook. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 3.

1855-9. Parl. San. Rep., Vol. II., p. 521. I left out the "Mean," it being decidedly too warm, generally 3 to 4°.

Months.	1853			Months.	1853		
	SR.	4h P.M.	Mean of the month.		SR.	4h P.M.	Mean of the month.
January	77·5	81·2	79·3	July	83·3	87·0	85·1
February	77·0	82·6	79·8	August	83·2	86·6	84·9
March	81·2	87·0	84·1	September	84·0	88·8	86·4
April	83·2	86·9	85·0	October	81·3	83·9	82·6
May	85·4	90·3	87·8	November	79·0	81·0	80·0
June	84·3	87·7	86·0	December	75·7	81·3	78·5

Isolated month (mean): 1854: January 78·8. (Mean of January 1853-4: 79·0.)

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
79·1	85·6	85·3	83·0	83·3

Pondichéri, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
11° 56′·0	79° 49′·1	L.a.L.S.

No year mentioned. Legentil in Kirwan. "Estimation de la température," p. 160. Means too warm; probably the thermometer was put up in a position in which disturbances by lateral radiation exercised great influence.

January	79·7	April	91·5	July	93·8	October	85
February	83	May	94	August	92	November	81·2
March	88	June	95·4	September	89·5	December	80·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
81·0	91·2	93·7	85·2	87·8

A more recent series of observations (which I introduced in the table of the Atlas), first published in the "Annuaire météorol. de la France," 2, p. 136, I found in Dove's "Nicht-periodische Aenderungen der Temperatur," VI., Berl. Acad. for 1858, publ. 1859.[1] It is decidedly more correct, though, from the hours being 8^h A.M., N., 4^h P.M., there is reason to believe it to be still rather too warm. The year is not mentioned.

App. Monthly means.

January	80·1	April	84·5	July	86·0	October	84·2
February	81·4	May	86·9	August	86·3	November	82·0
March	82·8	June	87·0	September	88·5	December	84·2

Mean of the seasons and the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.[1]
81·9	84·7	86·4	84·9	84·5

[1] Dove, as quoted above, has for the mean of the year 23·14° R., but it must be (= Mean of the 12 months) 23·41.

Punamáli, in the Karnátik.

Latitude North. 13° 3′ — Longitude East Green. 80° 7′ — Height. 89 feet.

1855-9. Lapsley. Daily extremes. Parl. San. Rep., Vol. II., p. 430.

1855 to 1859.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	74·2	80·4	78·3	July	82·0	86·0	84·0
February	76·4	81·2	78·8	August	81·8	84·4	83·1
March	78·0	82·0	80·0	September	79·4	83·4	81·4
April	80·0	85·2	82·6	October	77·8	82·0	79·9
May	80·8	86·0	83·4	November	75·0	80·4	77·7
June	82·4	87·2	84·8	December	75·6	81·6	78·6

General mean of the months and of the year.

Dec. to Febr.	March to May.	June to April.	Sept. to Nov.	Year.
78·6	82·0	84·0	79·7	81·1

Rajamándri, in Oríssa.

Latitude North. 17° 10′·5 — Longitude East Green. 81° 46′·6 — Height. 81 feet.

1854. Rankine. Nov. and Dec. incomplete. SR.; 10; 2; 4. Schlagintweit, "Met. Mscr.," Vol. 9.

1854.							
Months.	SR.	4h P.M.	Mean of the month.	Months.	SR.	4h P.M.	Mean of the month.
January	66·0	79·0	72·5	July	80·2	84·1	82·2
February	71·4	82·2	76·8	August	81·8	86·2	84·0
March	75·5	88·5	82·0	September	78·7	81·1	79·9
April	82·2	92·5	87·3	October	84·3	85·9	85·1
May	82·8	95·4	89·1	November	....	....	82
June	86·5	94·5	90·5	December	....	....	77½

Isolated months (mean). 1853: Jan. 73·4. Mean of 1853-4: Jan. 72·9.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·7	86·1	85·6	82·3	82·4

Saint Thomas Mount, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
13° 0′	80° 8′	314 feet.

1853-4. Dewes, Young, Medical officers of the Artillery cantonment. SR.; 10; 2; 4; 10. I took the mean of SR. and 4h P.M. as usual. The station is only 10 miles SW. from Madrás. — The place where the instruments had been put up was not quite so well protected against the glare radiating from the surrounding objects as in the Madrás observatory. This may have had some influence on raising the temperatures a little; but also the circumstance that the station Saint Thomas Mount was not in quite so free a position as that of Madrás certainly is of some influence.

Monthly means.							
Months.	1853	1854	Mean.	Months.	1853	1854	Mean.
January	80·7	79·2	79·9	July	88·5	90·5	89·5
February	80·6	80·5	80·5	August	86·1	90·0	88·0
March	83·2	80·5	81·8	September	87·0	87·0	87·0
April	85·3	88·5	86·9	October	84·5	83·0	83·7
May	90·2	91·5	90·8	November	80·0	80·0	80·0
June	88·2	92·5	90·3	December	79·0	(79·0)	79·0
				Year	84·4	85·2	84·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year
79·8	86·5	89·3	83·6	84·8

SÁLEM, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
11° 39′·2.	78° 8′·4 ʒ	907 feet.

1852-4. SCOTT; JOHNSTON; KEITH. SR.; 10; 4; SS. 1854: SR.; 10; 2; 4; 10.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 9.

Months.	1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	70·5	78·0	74·3	77·0	79·5	78·2	70·3	80·0	75·1	75·9
February	72·9	84·4	78·6	71·6	80·8	76·2	71·1	83·9	77·5	77·4
March	78·0	86·8	82·4	77·0	86·8	81·9	73·8	85·6	79·7	81·3
April	82·0	90·3	86·1	80·6	86·8	83·7	82·6	90·1	86·3	85·4
May	79·3	86·1	82·7	82·5	90·0	86·2	83·0	93·3	88·1	85·7
June	78·2	83·8	81·0	80·3	86·6	83·4	81·6	90·1	85·8	83·4
July	78·2	84·6	81·4	73·5	88·5	81·0	78·3	87·0	82·6	81·7
August	78·3	84·7	81·5	78·5	82·5	80·5	79·0	85·5	82·2	81·4
September	77·8	83·3	80·5	78·8	85·8	82·3	79·9	86·4	83·1	82·0
October	77·1	82·3	79·7	77·1	82·0	79·6	78·1	84·5	81·3	80·2
November	74·0	77·8	75·9	72·8	78·3	75·6	75·9	81·6	78·7	76·7
December	73·3	78·3	75·8	72·9	82·6	77·7	73·0	79·4	76·2	76·6
Year	for 1852: 80·0			for 1853: 80·5			for 1854: 81·4			80·6

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
76·6	84·1	82·2	79·6	80·6

Súrat, in the Kónkan.

Latitude North.	Longitude East Green.	Height.
21° 10′	72° 52′	L.a.L.S.

1850-60. Pelly. Extremes and mean; the latter is deduced from sunrise and about the mean of the afternoon. Parl. San. Rep., p. 791.

1850 to 1860.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	59·1	87·3	72·9	July	77·9	89·9	84·0
February	69·2	91·3	76·9	August	78·6	87·0	82·5
March	70·1	97·7	84·1	September	77·1	89·9	83·3
April	75·9	100·5	88·0	October	72·9	82·8	82·6
May	80·0	100·4	89·4	November	66·9	90·5	78·1
June	80·1	94·3	87·1	December	62·5	87·5	74·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
74·7	87·2	84·5	81·3	81·9

Tinnevélli, in the Karnátik.

Latitude North.	Longitude East Green.	Height.
8° 43′·8	77° 40′·4 ♁	120 feet.

1854. Jail Hospital. SR.; 10; 2; 4; 10. Schlagintweit, "Met. Mscr.," Vol. 3.
(January only approximation, incomplete.)

1854.							
Months.	SR.	4^h P.M.	Mean of the month.	Months.	SR.	4^h P.M.	Mean of the month.
January	....	....	(81·2)	July	83·6	87·2	85·4
February	78·2	85·2	81·7	August	83·1	87·1	85·1
March	81·6	87·5	84·5	September	83·5	88·5	86·0
April	85·1	92·1	88·6	October	80·8	87·2	84·0
May	84·1	92·0	88·0	November	78·0	83·3	80·6
June	86·3	91·3	88·8	December	77·2	84·6	80·9

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
81·3	87·0	86·4	83·5	84·6

TRICHINÁPALI.

Latitude North.	Longitude East Green.	Height.
10° 49′·8	78° 40′·95	443 feet.

1853 and 1854. GRAHAM. Only means communicated; the hours of observation seem not to have been kept very regularly; for this region, however, this is not of great influence on the monthly mean.

Months.	1853 Mean of the month.	1854 Mean of the month.	General mean.	Months.	1853 Mean of the month.	1854 Mean of the month.	General mean.
January	81·0	79·5	80·2	July	84·5	85·7	85·1
February. . . .	82·8	83·5	83·1	August	83·3	86·5	84·9
March	84·0	88·7	86·3	September . . .	83·3	85·5	84·4
April.	88·4	88·5	88·4	October	82·1	83·5	82·8
May	91·7	89·5	90·6	November. . . .	83·0	81·5	82·2
June	85·0	89·7	87·3	December	81·8	80·5	81·1
				Year	84·2	85·2	84·7

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
81·5	88·4	85·8	83·1	84·7

TRIVÁNDRUM, in Málabar.

Latitude North.	Longitude East Green.	Height.
8° 29′	76° 56′	L. a. L. S.

June 1837 to May 1842. CALDECOTT; *hourly* observations communicated in manuscript to Prof. DOVE, and the means published in his "Täglichen Veränderungen der Temperatur der Atmosphäre." Abh. Berlin Acad. for 1846, publ. 1848.

Means of the months.

January	78·1	April	82·7	July	78·0	October	78·5
February	79·7	May	81·5	August	78·3	November	77·6
March	81·7	June	78·5	September	78·5	December	78·1

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
78·6	82·0	78·3	78·2	79·3

VINGÓRLA, in the Kónkan.

Latitude North.	Longitude East Green.	Height.
15° 51'·2	73° 35'·9♁	L.a.L.S.

A. 1851-3. Means of isolated months. Communicated by MANESTRY.
SCHLAGINTWEIT, "Met. Mscr.," Vol. 39.

These are:

January, 1862	76	March, 1852	79	December, 1851	78
		1853	83		
		Mean	81		
February, 1852	81	April, 1851	82		
1853	81	1852	81		
Mean	81	Mean	81½		

These were the only values I could communicate in my memoirs to the Royal Society 1863.

B. 1857. GEORGE. Mean of extremes, Parl. San. Rep., Vol. II., p. 904. The latter series being by far more complete, I excluded the values given above from the mean.

1857							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	71·1	83·3	77·2	July	74·8	82·6	78·7
February	70·1	84·2	77·1	August	76·6	78·8	77·7
March	74·2	85·4	79·8	September	76·0	79·8	77·9
April	76·3	86·7	81·5	October	79·2	83·3	81·3
May	81·5	85·7	83·1	November	76·4	84·5	80·4
June	77·4	84·9	81·1	December	74·6	85·8	80·2

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
78·2	81·5	79·2	79·9	79·7

GROUP IX: CEYLON.

Bádula.	Kolómbo.	Pátlam.
Battikotta.	Máteli.	Peredénia.
Gálle.	Nurélia.	Trinkonomalí.
Kándi.		

Although Ceylon occupies an area of about 20,000 miles square, the type of climate varies but little, unless modified by elevation. In April and May, and a part of June, the quantity of rain increases with the south-west monsún; and this is still more the case in October, November, and the first half of December; in this latter period the wind is first variable, with storms from all parts of the compass; then the wind becomes ENE. and soon turns round to NE.; there is no month without some inches of rain.

Comparatively speaking, the weather may be said to be dry and hot from January to April or middle of May; moist and steamy from May to December, with some decrease of rain between June and October.

At some periods of the year it happens, notwithstanding the insular position of Ceylon, that in consequence of the general direction of the currents of the atmosphere coming down from the continental regions to its north, the moisture becomes remarkably reduced; the springs have been observed to approach dessication, and the level of tanks and sheets of water, such as the large lake near Kolómbo, have often sunk very considerably, even after the rains in May. Such was the case in the middle of September 1855. Such drought is but of short duration; it is chiefly the period next preceeding the beginning of the SW. as well as of the NE. monsún, which shows this exceptional dryness.

At Kolómbo clouds of red dust then become annoying near the station; but many more are the days of the year when driving rain can scarcely be kept off by

verandahs and Venetian blinds, and moisture is deposited on walls and floors. In the cooler season dense fogs arise in the morning, about the time of the minimum of day: they disperse after 2 to 3 hours; but you generally still see, for some time after, your respiration in the muggy atmosphere.

January is not unfrequently unpleasant and unhealthy, partly by being oppressive, partly by a chilly trying wind, such as the "long-shore wind" of Kolómbo.

February, if not too rainy, is often quite agreeable, as also August and September; and then only the full glory of the grand tropical features of the country can be properly enjoyed by the European, unless he retires to the higher regions, where the climate, though pleasant in every respect, still allows him to see enough of splendid foreign type.

The island altogether is situated to the south of the zone of maximum of mean temperature, which includes the regions near Trichinápali; the thermal equator also crosses Ceylon. The northern regions therefore, as was to be expected, show the greatest heat in Ceylon; so it is in Trinkonomalí and Ba'ttikótta. From March to August the climate is dry and hot, rain falling but seldom; also the SW. monsún does not bring much rain, when we consider its effects on the east coast of southern India; but from October to December, and a part of January, rain with high winds and storms is the more constant.

The *absolute Extremes* I selected for Kolómbo for the year 1855 from the registers of the Royal Engineers.

The *mean insolation* is very valuable also for the Indian archipelago in general, for which we have no detail so complete; it is the mean of six years, from the Kolómbo observatory.[1]

[1] "On the Agricultural, Commercial, Financial, and Military Statistics of Ceylon," compare the recent communications of T. R. Power to the Royal Asiatic Society. London, New Series, Vol. I., pp. 42-50, 1864.

Absolute Extremes.

Kolómbo, 1855.					
Months.	Min.	Max.	Months.	Min.	Max.
January	68·4	85·0	July	77·2	86·0
February	69·0	88·5	August	74·8	85·5
March	72·3	88·0	September	73·0	85·0
April	73·0	89·5	October	72·2	84·0
May	70·0	88·0	November	71·0	85·5
June	78·0	87·0	December	69·0	85·0

Mean Insolation.

Kolómbo, 1853-1859.							
January	109	April	105	July	98	October	103
February	111	May	98	August	103	November	107
March	111	June	99	September	102	December	106

Plate of the Atlas: The landscape from the *Environs of Galle*, in reference to meteorology, is to show the effect of a sudden break of short duration in one of the rainy days of May. The atmosphere, though oppressive enough in reality, looks brilliant and mild, and its steamy haze materially contributes to increase the picturesque effect of the rich and varied groups of tropical vegetation. Or. No. 7. Part II., No. 15.

Bádula.

Latitude North.	Longitude East Green.	Height.
6° 59′	81° 11′	2,450 feet.

No year mentioned. Martin. British Colon., 1843, p. 374. 8; 12; 8. Means.

January	$66\frac{2}{3}$	April	$71\frac{1}{3}$	July	$69\frac{1}{3}$	October	$72\frac{1}{3}$
February	$68\frac{1}{3}$	May	$72\frac{1}{3}$	August	72	November	71
March	$68\frac{1}{3}$	June	71	September	$72\frac{1}{3}$	December	$70\frac{1}{2}$

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
68·5	70·7	70·8	71·9	70·5

Battikótta.

Latitude North.	Longitude East Green.	Height.
9° 36′	80° 0′	L.a.L.S.

1847-9. Communicated by Fr. Layard. SR.; 9^h 30′; 3^h 40′. Schlagintweit, "Met. Mscr.," Vol. 4.

Mean $= \dfrac{\text{SR.} + 3^h\,40'}{2}$.

Months.	1847.	1848.	1849.	General mean.	Months.	1847.	1848.	1849.	General mean.
	Mean of the month.					Mean of the month.			
January	78·0	78·2	79·2	78·5	July	83·7	82·9	83·2	83·3
February	81·2	79·9	80·6	80·6	August	83·8	82·4	83·5	83·2
March	82·1	82·8	82·4	82·4	September	82·4	82·7	83·5	82·9
April	84·6	85·4	85·4	85·1	October	82·6	81·5	82·8	82·3
May	85·5	85·1	85·7	85·4	November	80·2	79·1	80·4	79·9
June	84·6	84·5	84·6	84·6	December	78·6	78·4	78·1	78·4
					Year.	81·8	82·7	82·4	82·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
79·2	84·3	83·7	81·7	82·2

GÁLLE.

Latitude North.	Longitude East Green.	Height.
6° 2'·5	80° 10'·8	L.a.L.S. (21 feet.)

A. Means, approximation, but, as it seems, carefully combined by DAVIS. Parl. San. Rep., Vol. II., p. 949.

B. 1856. Mean of the year communicated by NIETNER, without further details; it agrees very well with the mean of Dr. DAVIS's observations.

1857. The month of May, from our assistant MONTEIRO's observations.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 17.

A. The year is not indicated.

January . . .	80	April . . .	82	July	81½	October	80
February . . .	79½	May . . .	82½	August	81	November . . .	80
March	80	June . . .	82	September . .	81	December . . .	79

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
79·5	81·5	81·5	80·3	80·7

B. Mean of 1856: 81·0.

C. Mean of May 1857: 82·1.

Kándi.

Latitude North.	Longitude East Green.	Height.
7° 17′	80° 49′	1,739 feet.

1819, 1833-5. Means calculated by Dove. Berl. Acad. 1847.—1819: 6—7; 12; 9—11. 1853-5: Max. and Min.

Months.	1819.	1834.	1835.	Months.	1819.	1834.	1835.
Mean of the month.							
January	70·0	71·8	70	July	73	72·7	72 3/4
February	71 1/3	73·5	72 3/4	August	74	72·3	72 2/3
March	73 1/2	75·5	73 1/4	September	73	73·1	72
April	74	73·3	74	October	73	72·7	71
May	73 2/3	76·3	73 3/4	November	73	72·1	72
June	73	73·8	72 2/3	December	72	70·5	72 1/2
				Year	72·8	73·1	72·4

1833. Isolated months (also included in the mean). Nov. 72. Dec. 72 1/3.

General mean of the months.							
January	70·6	April	73·8	July	72·5	October	72·2
February	72·5	May	74·6	August	73·3	November	72·1
March	74·0	June	73·1	September	72·7	December	71·8

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
71·6	74·1	73·0	72·3	72·8

KOLÓMBO.

Latitude North.	Longitude East Green.	Height.
6° 56′·6	79° 49′·8	L. a. L. S. (18 feet.)

A. 1812. Edinb. Journ of Sc., V., p. 142; mean $= \frac{6 + 3 + 9}{3}$.

1815. DAVY. Account of Ceylon; mean $= \frac{7 + 3}{2}$.

1852-5. Officers commanding the Royal Engineers: HAWKSHAW, HOPE, PHILPOTTE; Max., Min., $9\frac{1}{2}$; $3\frac{1}{2}$. This very careful series included, besides the temperature, many most detailed observations on moisture, insolation, &c.

The very small variation of the temperature at *Ceylon* allowed of my including 1812 and 1815 in the general mean.

B. 1853-9. The mean of this series is contained in the Parl. San. Rep., Vol. II., p. 920. I add the "Mean dry bulb," but I did not include it in the general mean, as from the combination of the hours (not detailed) it is throughout warmer, also when compared to those years included in the same period for which I had compared the copy of the full details.

A. Months.	1812	1815	1852			1853			1854			1855			General mean.
	Mean of the month.	Mean of the month.	SR.	$3\frac{1}{2}^h$ P.M.	Mean of the month.	SR.	$3\frac{1}{2}^h$ P.M.	Mean of the month.	SR.	$3\frac{1}{2}^h$ P.M.	Mean of the month.	SR.	$3\frac{1}{2}^h$ P.M.	Mean of the month.	
Jan.	79·0	79·2	....	....	....	75·5	83·3	79·4	73·1	83·5	78·3	72·8	82·9	77·8	78·7
Febr.	80·0	80·4	....	....	....	74·7	84·5	79·6	74·6	84·2	79·4	73·3	83·3	78·3	79·5
March	81·5	82·38	....	....	....	77·0	86·1	81·5	75·9	85·2	80·5	75·3	85·1	80·2	81·2
April	83·0	84·33	75·8	87·8	81·8	77·3	85·7	81·5	78·8	86·0	82·4	76·1	86·0	81·0	82·4
May	83·1	83·8	78·6	83·7	81·1	78·9	84·7	81·8	74·4	84·0	79·2	78·4	85·1	81·7	81·8
June	81·75	81·7	79·0	83·7	81·3	80·1	83·6	81·8	78·5	82·9	80·7	77·3	83·4	80·3	81·3
July	81·75	80·3	79·3	83·5	81·4	77·7	82·2	79·9	77·5	81·8	79·6	78·7	83·3	81·0	80·7
Aug.	80·9	80·6	78·3	82·8	80·5	78·9	82·7	80·8	78·6	81·8	80·2	77·2	82·6	79·9	80·5
Sept.	81·5	80·23	77·6	82·3	79·9	78·1	83·2	80·6	78·4	82·5	80·4	77·0	82·0	79·5	80·3
Oct.	79·63	79·4	74·9	82·3	78·6	76·8	82·7	79·7	76·1	81·7	78·9	75·5	81·4	78·4	79·1
Nov.	80·75	78·75	74·0	82·9	78·4	74·5	82·5	78·5	74·7	81·8	78·2	74·0	82·8	78·4	78·8
Dec.	79·8	77·85	72·9	81·9	77·3	73·3	83·0	78·1	74·2	82·4	78·3	72·7	81·5	77·1	78·1
Year	81·0	80·75	for 1852:			for 1853: 80·3			for 1854: 79·7			for 1855: 79·5			80·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
78·8	81·8	80·8	79·4	80·2

B. 1853 to 1859.

January . . .	81	April	84·2	July	81·7	October . . .	81·1
February . .	82·2	May	83·4	August . . .	80·9	November . .	81
March	83·7	June	82·2	September .	81·6	December . .	80·8

MÁTELI.

Latitude North.	Longitude East Green.	Height.
7° 32′	80° 47′	1,187 feet.

1854-6. Communicated by FR. LAYARD. Means based on $\frac{SR. + 3}{2}$.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 4.

1855. Mean of the months.

January	70·8	May	79·7	September	77·2
February	72·6	June	79·7	October	75·6
March	75·2	July	78·9	November	74·5
April	78·5	August	77·6	December	71·5

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
71·6	77·8	78·7	75·8	76·0

Isolated months (mean).

Dec. 1854: 72·6. Mean 1854-5: 72·0.

Jan. 1856: 70·4. Mean 1855-6: 70·6.

Nurélia.

Latitude North.	Longitude East Green.	Height.
7° 13′	81° 52′	6,218 feet.

1835. Fr. Layard. Mean $\frac{SR. + 3\frac{1}{2}}{2}$.

Schlagintweit, "Met. Mscr.," Vol. 4.

1835. Mean of the months.								
January	55·9	April	59·0	July	59·6	October	(58·5)	Approximations, calculated for obtaining the mean of the year.
February	58·0	May	60·1	August	59·1	November	(58)	
March	59·7	June	59·2	September	59·0	December	(57)	

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
57·0	59·6	59·3	58·5	58·6

Pátlam.

Latitude North.	Longitude East Green	Height.
8° 2′·8	79° 53′·6	L. a. L. S.

1847-8. Communicated by Fr. Layard. Means; probably the observation at 9h A.M.

Schlagintweit, "Met. Mscr.," Vol. 4.

1857-8. Mean of the months.							
January	75·5	April	83·2	July	79·9	October	80·3
February	78·9	May	81·1	August	81·4	November	78·2
March	83·0	June	82·1	September	80·4	December	77·7

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
77·4	82·4	81·1	79·6	80·1

PEREDÉNIA (4 miles from Kándi.)

	Latitude North.	Longitude East Green.	Height: (Peredénia).
Kándi	7° 17′	80° 49′	1,650 feet.

1853-5. Royal Engineers. Max.; Min.; 9½; 3½. Besides these I obtained from Mr. LAYARD some isolated observations for 1851-2.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 4.

1851-8. Parl. San. Rep., Vol. II., p. 930. The values are said there "to be far from being perfect." I therefore left them out, though they are but a little too warm compared to those I had obtained.

Months.	1853			1854			1855			General mean.
	Min. (=SR.)	$3\frac{1}{2}^h$ P.M. (= 4^h)	Mean of the month.	Min. (= SR.)	$3\frac{1}{2}^h$ P.M.	Mean of the month.	Min. (= SR.)	$3\frac{1}{2}^h$ P.M.	Mean of the month.	
January	....	....	....	68·2	79·6	73·9	67·8	78·0	72·9	73·4
February	....	....	....	67·6	82·8	75·2	69·3	79·9	74·6	74·9
March	....	....	....	67·3	85·0	76·1	70·6	83·4	77·0	76·5
April	....	....	....	71·5	84·5	78·0	72·1	83·9	78·0	78·0
May	72·9	81·8	77·3	72·8	80·7	76·7	74·9	83·4	79·1	77·7
June	72·6	78·8	75·7	72 0	77·5	74·7	72·4	81·0	76·7	75·7
July	71·5	78·5	75·0	73·6	78·3	75·9	74·2	80·7	77·4	76·1
August	70·6	78·7	74·6	72·7	77·8	75·2	73·6	79·7	76·6	75·5
September	70·8	82·0	76·4	72·8	78·8	75·4	72·4	79·6	76·0	75·9
October	69·8	78·9	74·3	71·1	77·5	74·3	71·4	78·0	74·7	74·4
November	68·6	76·9	72·7	70·5	78·3	74·4	71·0	79·1	75·0	74·0
December	66·0	77·5	71·7	70·0	78·5	74·2	69·0	77·8	73·4	73·1
Year	....	....	....	for 1854: 75·3			for 1855: 75·9			75·4

General means of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
73·8	77·4	75·8	74·8	75·4

TRINKONOMALÍ.

Latitude North.	Longitude East Green.	Height of fort.
8° 33′·5	81° 13′·2	213 feet.

A. 1809, 10 and 12. DAVY, "Account of Ceylon." Mean $= \frac{6 + 3 + 9}{3}$. When at Trinkonomalí, in April 1857, I was told that more recent observations had been made by Capt. HIGGS, but I could not obtain them.

A. 1809, 1810 and 1812.							
January	77·8	April	83·9	July	84·4	October	80·8
February	78·6	May	84·0	August	83·1	November	79·8
March	81·3	June	81·5	September	82·3	December	78·4

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
78·3	83·1	83	81	81·4

B. May 1857 to April 1860. COGAN. Mean of Extremes. Parl. San. Rep., Vol. II., p. 942. The first series being of so very early a date, I preferred introducing the latter alone into my general tables, without taking the mean of two series.

B. 1857 to 1860.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	$73^2/_3$	$83^1/_3$	78·5	July	$77^1/_3$	92	84·7
February	77	$85^2/_3$	81·3	August	$78^2/_3$	$92^2/_3$	85·7
March	$76^2/_3$	$88^1/_3$	82·5	September . . .	$77^2/_3$	$93^2/_3$	85·7
April	$79^2/_3$	92	85·8	October	76	91	83·5
May	78	$92^1/_3$	85·2	November	75	$88^1/_3$	81·6
June	$80^1/_3$	93	86·6	December	$75^1/_3$	85	80·1

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
80·0	84·8	85·7	83·6	83·5

GROUP X: INDO-CHINESE PENINSULA, ARCHIPELAGO, AND CHINA.

Ákyáb.	Lahát.	Sámarang.
Álor Gájah.	Makáo.	Sarăvak.
Áva.	Manilla.	Sándove.
Bangkók.	Mérgui.	Shangái.
Banjuvángi.	Pádang.	Singapúr.
Batavia.	Penáng.	Tavái.
Chúsan.	Palembáng.	Thayetmyó.
Hong-Kong.	Port Blair, Andamán.	Tónghu.
Kyuk-phyú.	Rangún.	Áden.
Labuán.		

In order to facilitate the connexion of the climatological character of India with meteorological elements of countries more or less distant therefrom, I added data from the eastern coast of the Bay of Bengál, the Archipelago, Áden, and some stations from China.

The provinces to the east of India Proper, till recently dependencies and military stations of Madrás, have now been raised to a provincial government. Not less important is it for the rapid progress of its development that General Phayre, its first governor, is the same who had done so much already to improve not only the political conditions of the province but also, and not less, its administration and national economy.

Of the stations from the Archipelago and the coasts of China only those are added to the registers which, by their low level, allowed of a direct comparison.

The *Archipelago*, as a rule, differs but little from what I had occasion to

detail about Ceylon; the mean of the year is a little cooler, the annual variation throughout smaller still than that in Ceylon.

At *Singapúr* two to three degrees is all the difference between the monthly means throughout the year; the rain is also pretty equally distributed over all the months, increasing a little from December to March. The malaria, jungly localities excepted, is not much to be feared; but the manufacture of sago is a great nuisance, affecting the air near the stations; and so is also, in the country, the burning of the manure used by Chinese cultivators.

At *Penáng* already the two monsuns are more distinct; the quantity of rain is greatest in May, and then in September and October. The heat, though not excessive, seldom over 90° Fahr., but again scarcely ever below 70°, is felt the more as in the evenings there is a remarkable absence of motion in the atmosphere.

For Bérma details are known for the delta of the Iravâdi, including its upper part. The humidity of the ground shows a decided effect also upon the air during the time of the periodic inundations. These are so general that at Áva all the wooden houses of the streets are raised several feet above the ground, a true city of "pile-buildings." Amongst the buildings of brick or stone, not very numerous altogether, those of the Bhuddist priesthood are the most conspicuous.

The heat in April and May seems to increase very rapidly with the distance from the sea-shore. At Tónghu and Prōm, from 8th to 10th May 1853, 107° was observed in houses, 115 in tents; at Shuagh-gīn it had reached 105°,[1] already at the end of April. Here, as in India in general, it is the south-west Monsún which brings the rain. The rain begins earlier than on the western coast, viz. about the middle of May or a little later; the thermometer then falls to 80° or 85° Fahr. The rain continues till about the end of September.

The climate, chiefly that of Mulmén, was found not to agree with the Indian native troops; those coming from the southern provinces suffered more from dysentery, fever, and rheumatism than the natives from Bengál. Amhérst, a short distance from Mulmén, is considered less unhealthy.

Higher up towards the north, *in the Bay of Bengál*, the seasons assume more decidedly

[1] I have no regular series of observations; these numbers were communicated to me personally by General Phayre and, through the kind mediation of the Commander-in-chief of Madrás, by correspondence with the resident officers.

still the character of the sea-shore of the Indian peninsula, only the daily variation is smaller. At Akyáb the rain begins about the 20th of May and for weeks it pours down with little interruption.

In Autumn and the cool season the climate differs but little from that of the western shores of the bay in the same latitude; on an average the eastern coasts are then a little cooler and more favoured by invigorating breezes.

The *absolute Extremes* are selected, for Rangún, from the observations of Dr. MONTGOMERY and Dr. FAYRER, May 1852 to April 1853. For the stations at a greater distance from the shore I have no data including all the year.

Absolute Extremes.

Rangún, 1852-3.					
Months.	Min.	Max.	Months.	Min.	Max.
January	62	92	July	75	89
February	59	97	August	76	$88^1/_2$
March	64	100	September	76	96
April	75	100	October	74	92
May	73	95	November	$69^1/_2$	$90^1/_2$
June	$75^1/_2$	90	December	62	90

Views from Pégu and Bĕrma are contained in great numbers in various publications by Major YULE; from the photographs of Capt. TRIPE I have executed in colours some of the objects referring to architecture and ethnography; they will be given later as oil-prints in the Atlas. (For illustrations of the Indian Archipelago I must refer to the Dutch colonial literature.)

AKYÁB, in Arrakán.

Latitude North.	Longitude East Green.	Height.
20° 80′	92° 52′·6	L. a. L. S.

1851-4. Communicated by CANNON. SR.; 10; 4; SS.; very careful; also the means for 1851 are based, as I was informed, on the mean of sunrise and an afternoon hour, about 3^h P.M.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 19.

Also for ÁRUG some observations by BELL are added, but they are very incomplete.

Months.	1851	1852			1853			1854			General mean.
	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January . . .	71·5	61·3	79·4	70·3	64·5	74·7	69·6	66·6	76·9	71·7	70·8
February . .	73·2	73·0	77·4	75·2	67·4	78·6	73·0	66·8	77·6	72·2	73·4
March . . .	76·9	79·7	82·4	81·0	73·4	85·2	79·3	73·3	82·5	77·9	78·8
April	83·0	84·8	86·1	85·4	80·3	86·6	83·4	79·9	84·8	82·3	83·5
May	85·1	85·0	86·2	85·6	84·0	89·5	86·7	82·3	87·7	85·0	85·6
June.	81·0	80·5	80·7	80·6	....	....	....	80·5	82·3	81·4	81·0
July	83·7	78·6	83·5	81·0	80·3	81·2	80·7	....	....	....	81·8
August . . .	83·4	79·3	80·0	79·6	79·5	81·4	80·4	79·5	82·0	80·7	81·0
September .	84·0	81·7	82·0	81·8	79·6	82·2	80·9	79·0	81·4	80·2	81·7
October . . .	83·1	79·1	84·3	81·7	....	....	....	78·5	83·3	80·9	81·9
November. .	81·5	73·4	77·5	75·4	71·2	80·0	75·6	73·2	79·9	76·5	77·2
December. .	75·1	70·3	77·8	74·0	67·5	75·8	71·6	64·4	76·5	70·4	72·8
Year . . .	80·1	for 1852: 79·3					....			....	79·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·3	82·6	81·3	80·3	79·1

Álor Gájah, near Maláka, Malay peninsula.

Maláka: Latitude North.	Longitude East Green.	Height.
2° 11′	102° 17′	L. a. L. S.

1832. Maurice. Journ. As. Soc., III., p. 615.

1832. Mean of the months.					
August	82·7	October	80·6	December	82·2
September	81·4	November	86·6		

Mean of the season.

Sept. to Nov.
81·8.

Áva, in Bérma.

Latitude North.	Longitude East Green.	Height:
21° 50′	96° 2′	L. a. L. S.

1830. Burney, in Martin, "British Colonies," 1843. Mean $\frac{6^h + 4}{2}$. Gleanings in Sc., 1830, p. 199; 1831, p. 416.

1830. Mean of the months.							
January	64·7	April	86·2	July	82·8	October	80·6
February	73·5	May	84·0	August	82·5	November	74·2
March	75·9	June	85·5	September	82·7	December	68·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
68·8	82·0	83·6	79·2	78·4

BANGKÓK, in Síam.[1]

Latitude North.	Longitude East Green.	Height.
14° 0′	101° 30′	L. a. L. S.

1840-47. CASWELL. Journ. Ind. Archipelago, II., p. 60. Probably $\frac{\text{Max.} + \text{Min.}}{2}$

Months.	1840	1841	1842	1843	1844	1845	1846	1847	General mean.
	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	
January . . .	72·2	78·8	79·3	77·5	74·6	74·1	77·2	74·7	76·7
February. . .	80·8	80·8	83·1	79·5	79·3	81·8	78·3	78·5	79·0
March	83·6	85·3	83·7	83·7	85·8	82·4	83·3	82·0	83·8
April	83·6	87·2	84·5	85·0	85·3	80·0	85·5	82·7	84·2
May	84·1	84·7	83·4	84·7	84·6	82·0	83·9	81·8	83·7
June	82·3	84·4	83·1	84·4	82·5	81·3	82·2	82·0	82·8
July	82·7	84·4	81·9	82·5	81·3	79·9	81·4	82·2	82·0
August	82·4	84·8	82·2	82·7	80·1	79·8	81·1	80·7	81·7
September . .	82·8	83·5	82·0	82·0	80·1	79·7	80·4	80·2	81·3
October . . .	81·8	84 5	80·6	81·3	79·7	78·9	80·7	78·9	80·8
November . .	81·2	82·6	78·9	80·8	77·5	76·8	77·2	79·0	80·5
December . .	76·3	80·4	77·1	75·4	77·0	76·9	75·5	76·9	76·9
Year	81·55	83·49	81·66	81·65	80·65	79·47	80·56	79·98	81·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
77·5	83·9	82·2	80·9	81·1

[1] "The Bangkok Calendar for the year of our Lord 1864. Compiled by D. B. BRADLEY, American Missionary Association," 1863, contains, as I have been informed, valuable details about climate, as well as numerical values of Temperature and Rain. The copy I wrote for had not yet reached me when this passed the press.

Banjuvángi, Jáva.

Latitude North.	Longitude East Green.	Height.
8° 17′	114° 26′	L. a. L. S.

1850-7. 6^h, 9^h, 3^h, 10^h. Means from Dove's "Nicht.-period. Temp." Part IV., 1859, p. 427.

January	80·2	May	80·0	September	79·1
February	80·0	June	80·0	October	80·4
March	80·6	July	78·7	November	80·4
April	81·1	August	78·7	December	80·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
80·1	80·6	79·1	80·0	79·9

Batavia, Island of Java.

Latitude North.	Longitude East Green.	Height.
6° 10′	106° 58′	L.a.L.S.

Jan. 1756 to June 1757. Kriel, in Edinb. Journ. of Sc., II., p. 133.
1846-47. Isolated months from Elliot's "Magnetic Survey." Phil. Trans. 1851.

A. 1756-7. Means of the month.

January	78	April	79	July	78	October	77
February	79	May	80	August	79	November	75
March	79½	June	77½	September	79	December	79

B. Isolated monthly means.

1846	November	80·3	1847	January	80·1	April	81·3
	December	79·8		February	79·6	May	81·2
				March	81·3	June	81·0

General mean.

January	79·0	April	80·1	July	(78·9)	October	(77)
February	79·3	May	80·6	August	(79)	November	77·6
March	80·4	June	79·2	September	(79)	December	79·4

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
79·2	80·4	79·0	77·9	79·1

Buitenzorg, on the Island of Jáva.

Latitude South.	Longitude East Green.	Height.
14° 28′·0	79° 58′·3	880 feet.

Means in Dove, Berl. Acad., 1847 and 1853. The height and the temperature of the Jáva Hill-stations[1] above Buitenzorg were communicated in a descriptive account of the climate by Dr. Friedmann, 1864.

Mean of the month.

January	75·2	April	76·7	July	76·0	October	77·9
February	75·6	May	77·2	August	76·7	November	76·7
March	76·2	June	76·5	September	77·2	December	77·0

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·9	76·7	76·4	77·3	76·6

[1] Hillstations of Jáva: means of the year.

Upper Salak	4580	66·1	Malabar	7700	58·5
Lower Salak	5110	61·5	Gunong Merapi	8700	51·8
Tikokur....	6100	60·3			

For details of meteorology and physical geography I refer to Junghuhn's well known work, "Java;" 2nd edition of the German translation by Hasskarl, 1857.

Chúsan, on the China coast.

Latitude North.	Longitude East Green.	Height.
30° 25′	121° 44′	L.a.L.S.

1840-1. Isolated months. New York, Met. Returns, 1841, p. 308. Mean $= \frac{9+9}{2}$; from Dove, Berl. Acad., 1847, p. 99.

1840				1841	
Mean of the month.				Mean of the month.	
September	$77\frac{3}{4}$	November	$57\frac{1}{2}$	January	$40\frac{1}{2}$
October	$68\frac{1}{4}$	December	$43\frac{1}{2}$	February	$38\frac{3}{4}$

Seasons.

Dec. to Febr.	Sept. to Nov.
40·9	67·8

HONG KONG ISLAND, China coast.

Latitude North.	Longitude East Green.	Height.
22° 11′	114° 7′	140 feet.

1842-5. EATWELL. 7^h A.M.; 3^h P.M.; 9^h P.M. I deduced the daily mean (in analogy with the formula used by KÄMTZ) from $\frac{7+3+2\times 9}{4}$. The hours differing in details from those generally given here, I gave only the means I obtained. SCHLAGINTWEIT, "Met. Mscr.," Vol. 18.

Months.	1842	1843	1844	1845	General mean.	Months.	1842	1843	1844	1845	General mean.
	Mean of the month.						Mean of the month.				
January	....	59·2	61·7	83·1	68·0	July	....	86·9	85·1	....	86·0
February	....	61·7	60·9	67·0	63·2	August	....	83·8	82·5	....	83·1
March	....	62·3	68·7	65·4	65·5	September	....	84·3	82·7	....	83·5
April	....	74·8	72·8	....	73·8	October	....	78·0	79·1	....	78·5
May	....	79·8	81·7	....	80·7	November	....	76·0	67·8	....	71·9
June	....	85·0	83·9	....	84·4	December	66·8	65·0	64·5	....	65·4
						Year	....	74·7	74·3	....	75·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
65·5	73·3	84·5	78·0	75·3

KÁNTON (KUANG-TONG), in the province of China of the same name.

Latitude North.	Longitude East Green.	Height.
23° 8′	113° 16′	L.a.L.S.

1829-38. SILLIMAN's Am. Journ., XXXVIII., p. 272. — DOVE's "Non-per. Variat.," IV., Berl. Acad., also contain an older series, from 1785; the mean of the year is 72·12.

1829-38. General mean of the month.							
January	52·5	April	70	July	83	October	73·3
February	55	May	77	August	82	November	65·2
March	62·5	June	81	September	80	December	57·1

General means of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
54·8	69·8	82·0	72·8	69·9

KYUK-PHYÚ, in Arrakán.

Latitude North.	Longitude East Green.	Height.
19° 25′·2	93° 32′·2ℨ	L.a.L.S.

1853 and 1854. THOMAS. SR.; $9^h 50^m$; N.; $2^h 40^m$; 4^h; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 19.

Months.	1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	68·9	76·5	72·7	68·4	82·8	75·6	74·15
February	72·7	79·7	76·2	67·1	73·8	70·45	73·3
March	69·6	83·6	76·6	73·5	86·1	84·8	80·7
April	81·8	93·0	87·4	82·0	92·6	87·3	87·35
May	81·7	94·7	88·2	80·5	92·8	86·65	87·4
June	78·8	87·0	82·9	76·1	81·1	78·6	80·75
July	78·0	83·2	80·6	75·2	82·4	78·8	79·7
August	78·6	81·7	80·15	72·8	77·3	75·05	77·6
September . . .	78·5	84·8	81·65	76·7	82·9	79·8	80·7
October	80·1	91·0	85·55	76·1	86·1	81·1	83·3
November	. . . .	. . . .	. . . . .	72·9	82·9	77·9	(77·9)
December	69·4	78·4	73·9	69·5	78·9	74·2	74·05
Year			. . . . .	for 1854: 79·2			79·7

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
73·8	85·1	79·3	80·6	79·7

Labuán, an island off the coast of Borneo.

Latitude North.	Longitude East Green.	Height.
Ab. 3°	Ab. 101⅓	108 feet.

1858 and 1860. Incomplete observations. Parl. San. Rep., Vol. II., p. 579.

The island is about 30 miles in circumference, several large rivers, and an elevation in its central parts, in the form of a narrow ridge, to about 300 feet; the exact position is not indicated. The town of Labuán is chiefly inhabited by Chinese and Klings.

1858 and 1860.			
Months.	Min.	Max.	Mean.
January	77	87	82
February	79	88	83½
March	76	90	83
April	77	89	83
May	75	92	83½
Estimated mean of the year: 84°.			

Lahát, Sumátra.

Latitude South.	Longitude East Green.	Height.
3° 48′	104° 0′	L. a. L. S.

1845-52. 6; 12; 7. Means from Dove's "Nicht-period. Temp.," Part IV., 1859, p. 427. From analogy with the hourly variations between morning and evening at Kólombo, I have corrected these combinations of the three hours for — 0°·3 Fahr.

January	79·0	May	79·8	September . . .	79·9
February	79·9	June	80·6	October	80·8
March	81·5	July	80·3	November	79·9
April	81·2	August	79·9	December	79·2

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
79·4	80·8	80·3	80·2	80·2

Makáo, Island of Hiang-shang, Chinese coast.

Latitude North.	Longitude East Green.	Height.
22° 11′	113° 34′	L. a. L. S.

1827-30. Beale, in Meyen, "Klima des südlichen China." — 6^h; 4^h.

1827-30. General mean of the month.							
January	62·0	April	71·3	July	82·9	October	76·1
February	54·9	May	78·4	August	83·1	November	67·4
March	64·3	June	82·7	September	81·6	December	61·2

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
59·4	71·3	82·9	75·0	72·2

Manilla, in Luzon, Philippine Islands.

Latitude North.	Longitude East Green.	Height.
14° 36′	121° 9′	L. a. L. S.

1841-4. Calculated by Dove. Berl. Acad., 1853, p. 166, from Cécile "Campagne dans les mers de l'Inde et de la Chine." (The older data in Kirwan's "Estimation de la Température" are but approximations.) May is interpolated for the purpose of obtaining the mean.

1841-44. General mean of the month.							
January	77·1	April	81·5	July	80·2	October	79·9
February	77·5	May	(81·7)	August	78·9	November	79·7
March	79·5	June	81·3	September	78·8	December	78·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
77·6	80·9	80·1	79·5	79·5

Mérgui, in Tenásserim.

Latitude North.	Longitude East Green.	Height.
12° 27′	98° 35′	L. a. L. S.

1853 and 1854. Waring; Evegard. Min.; 10; 4. — SR.; 10; 2; 4; 10.
Schlagintweit, "Met. Mscr.," Vol. 6.

Months.	1853.			1854.			General mean.
	Min.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	73·0	84·1	78·5	76·5	84·8	80·6	79·5
February	73·9	84·6	79·2	81·6	85·2	83·4	81·3
March	74·8	84·0	79·4	78·5	85·2	81·8	80·6
April	77·2	85·5	81·3	80·9	87·7	84·3	82·8
May	75·9	81·6	78·7	79·3	83·4	81·3	80·0
June	75·5	79·2	77·3	78·5	81·4	79·9	78·6
July	73·5	78·6	76·0	77·7	83·9	80·8	78·4
August	75·3	81·7	78·5	75·7	81·9	78·8	78·6
September	75·5	82·6	79·0	73·9	78·4	76·1	77·5
October	77·5	83·7	80·6	74·5	82·6	78·5	79·5
November	....	....	....	....	....	....	....
December	....	....	....	....	....	....	....

General mean of the seasons.

March to May.	June to Aug.
81·1	78·5

PÁDANG, Indian Archipelago.

Latitude South.	Longitude East Green.	Height.
0° 59′	100° 31′	L. a. L. S.

1847 and 1848. ELLIOT. Phil. Transact., 1857.

1847 and 1848. Mean of the month.			
October	80·5	January	81·7
November	80·8		
December	81·3		

PALEMBÁNG, Sumátra.

Latitude South.	Longitude East Green.	Height.
2° 50′	104° 53′	L. a. L. S.

1850-56. 6; 9; 3; 10. Means from DOVE's "Nicht-period. Temp.," Part IV., 1859, p. 427.

January	79·7	May	81·1	September	81·1
February	80·0	June	80·4	October	80·9
March	80·6	July	80·0	November	80·6
April	80·9	August	80·0	December	80·0

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
79·9	80·9	80·1	80·9	80·4

Penáng, on the Prince of Wales Island, in the Straits.

Latitude North.	Longitude East Green.	Height.
5° 28′	100° 22′	L.a.L.S.

1859. Burn. Parl. San. Rep., Vol. II., p. 587. What is called Mean Temperature in the tables must include the evening observations, being generally warmer than the mean of the extremes.

1859.							
Months.	Min.	Max.	Mean.	Months.	Min.	Max.	Mean.
January	76·8	82·8	79·8	July	78·9	85·0	81·9
February	77·5	84·4	80·9	August	78·0	84·0	81·0
March	78·5	84·9	81·7	September . . .	77·5	83·8	80·7
April	79·0	85·4	82·2	October	75·9	82·5	79·2
May	78·0	84·4	81·2	November	77·0	82·7	79·8
June	79·3	85·7	82·5	December	74·4	82·2	78·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
79·7	81·7	81·8	79·9	80·8

Port Blair, Andamán Islands.

Latitude North.	Longitude East Green.	Height.
11° 42′	92° 57′	L.a.L.S.

Macpherson. Madras Sanitaria Rep., 1862, p. 80. 1858, 59, and 60. Mean of the year: 81.

I have not yet been able to obtain any further details; they may be soon expected, the station having so much increased, that recently, February 1864, the foundation of a church has also been laid.

Rangún, in Pégu.

Latitude North.	Longitude East Green.	Height.
16° 45′	96° 17′	L.a.L.S. (40 feet.)

A. 1852. Montgomery. May, June, July, August, October. SR.; 9; 3; SS.
Schlagintweit, "Met. Mscr.," Vol. 19.

1852, July and August. Fayrer. SR.; 9; 12; 3; SS.; 9; in Journ. As. Soc. Beng. for 1852, pp. 520 and 622, and

September 1852 to April 1853; from a private communication by Dr. Macpherson.

(Nov. 1852 to Nov. 1853. Data for this period are contained in Parl. San. Rep., Vol. II., p. 525.)

The means here given are $\frac{SR. + 3}{2}$; for July, August, and October 1852, the values of both series are combined.

B. 1856, 59, and 60. Means communicated in the Madrás Mountain and Marine Sanitaria Reports, 1862, p. 354.

Months.	*A.* 1852-3.	*B.* 1858-60.	General mean.	Months.	*A.* 1852-3.	*B.* 1858-60.	General mean.
January	73·2	74	73·6	July	80·2	82·0	81·1
February	79·3	75·7	77·5	August	78·0	80·5	79·2
March	80·5	77·1	78·8	September	80·3	81·7	81·0
April	83·0	82·5	82·7	October	82·3	82	82·1
May	80·2	81·1	80·7	November	81·1	78·3	79·7
June	79·7	80	79·9	December	76·7	75	75·8

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
75·6	80·7	80·1	80 9	79·3

ROSS ISLAND, in the Mérgui Archipelago.

Latitude North.	Longitude East Green.	Height.
11° 41′	92° 39′	160 feet.

Dec. 1859 to July 1860. SR.; 10; 4; 10. From observations by Dr. WELSH, communicated by the government of India to the Asiatic Society. Journ. As. Soc. Bengál, Vol. 280, pp. 32-41.—It could no more be entered in the general table, No. I. of the meteorological plates. No means are calculated; I took them, as usual, from $\frac{\text{SR.} + 4^{\text{h}}\ \text{P.M.}}{2}$ for the daily period.

Means of the month.							
Months.	S.R.	4^{h} P.M.	Mean of the month.	Months.	SR.	4^{h} P.M.	Mean of the month.
January	76·5	80·4	78·4	May	80·2	84·0	82·1
February	77·4	82·8	80·1	June	80·0	83·1	81·5
March	76·1	83·5	79·8	July	79·4	83·0	81·2
April	78·6	84·1	81·3	December	77·9	80·8	79·3

Mean of the seasons: Dec. to Febr. 79·3; March to May 81·1.

SÁMARANG, in the Indian Archipelago.

Latitude South.	Longitude East Green.	Height.
7° 0′	110° 31′	L.a.L.S.

1838 and 1839. Jan. to March. PERRET. Re-calculated by DOVE. Berl. Acad., 1847, p. 113. 8; 12; 4; 8. They were first published in BOSCH, "De dysenteria tropica."

1838 and 1839. Means of the month.							
January	80·1	April	82·6	July	80·5	October	84·2
February	80·8	May	82·5	August	82·1	November	83·6
March	80·5	June	81·1	September	83·1	December	81·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
80·7	81·9	81·2	83·6	81·9

SARÁVAK, Indian Archipelago.

Latitude North.	Longitude East Green.	Height.
1° 34′	110° 29′	L.a.L.S.

1846, in ELLIOT. Phil. Trans., 1851. Isolated months (mean).

June 79·6 July 78·8 Aug. 78·7

SÁNDOVE, in Arrakán.

Latitude North.	Longitude East Green.	Height.
18° 25′	94° 30′	L.a. L.S.

(1851, Journ. As. Soc.; excluded on account of considerable and irregular deviations.)

1852-4. DAVIS; BELL; JONES. SR.; 10; 4; SS. SCHLAGINTWEIT, "Met. Mscr.," Vol. 19.

Months.	1852			1853			1854			General mean.
	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	56·5	82·5	69·5	55·6	82·3	68·9	57·6	80·0	68·8	69·1
February	57·6	85·5	71·6	59·5	85·8	72·6	57·2	82·6	69·9	71·4
March	....	....	....	65·7	89·8	77·7	61·6	86·8	74·2	75·9
April	76·2	88·8	82·5	75·7	90·8	83·3	70·8	88·9	79·8	81·9
May	77·2	88·6	82·9	76·8	87·9	82·3	75·5	88·2	81·8	82·3
June	76·3	83·7	80·0	75·9	84·7	80·3	75·7	85·0	80·3	80·2
July	72·5	82·3	77·4	70·8	80·5	75·6	77·4	82·6	80·0	77·7
August	71·7	84·6	78·1	75·5	82·3	78·9	78·0	81·9	80·0	79·0
September	73·8	84·8	79·3	75·3	83·7	79·5	78·0	81·8	79·9	79·6
October	74·0	87·7	80·8	76·7	85·6	81·1	75·6	85·0	80·3	80·7
November	65·6	86·1	75·8	68·9	84·5	76·7	69·1	84·1	76·6	76·3
December	58·9	83·7	71·3	61·6	81·8	71·7	62·5	81·8	72·1	71·7
Year			....	for 1853: 77·4			for 1854: 77·0			77·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
70·7	80·0	79·0	78·9	77·1

Shanghái, Province of Kiangsú, in China.

Latitude North.	Longitude East Green.	Height.
31° 2′	121° 20′	L. a. L. S.

A. 1844 and 1845. Fortune, "Journey to the Tea Countries," p. 89.
B. 1849-55. Eatwell. Min. and Max. 7^h A.M.; 3^h P.M.; 9^h P.M.
Schlagintweit, "Met. Mscr.," Vol. 18.

For the calculation of the mean, $= \frac{7 + 3 + 2 \times 9}{4}$, compare Hong-Kong.

First series. 1844-45. Mean of the month.

January .	40·5	April . . .	57·0	July . . .	83·5	October	64·5
February.	41·0	May . . .	65·0	August . .	83·0	November	58·0
March . .	48·6	June . . .	72·0	September	73·0	December	42·0

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
41·2	56·9	79·5	65·2	60·7

Second series.

Months.	1849	1850	1851	1852	1853	1854	1855	Mean.
January	39·0	38·5	41·5	38·5	41·5	43·5	39·0	40·2
February	44·5	38·5	41·0	37·5	37·5	37·5	40·0	39·5
March	47·5	48·0	46·0	44·0	48·5	46·0	47·0	46·7
April	54·5	54·5	53·0	54·5	69·5	56·0	56·5	56·9
May	64·5	67·0	63·0	66·0	65·0	66·5	68·0	65·7
June	67·0	70·0	68·0	69·0	69·5	69·5	70·0	69·0
July	78·0	80·0	81·0	84·5	84·5	82·5	83·0	81·9
August	81·0	83·0	81·5	81·5	79·0	83·5	82·0	81·6
September	74·5	74·0	72·0	72·0	75·5	74·0	79·0	74·4
October	64·0	66·5	60·0	65·5	66·0	84·5	65·0	67·3
November	52·0	55·0	56·5	55·5	57·5	59·5	55·0	55·8
December	45·0	46·5	44·5	42·5	45·5	46·5	. . . .	45·1
Mean	59·3	60·1	59·0	59·2	61·6	65·0	62·2	60·3

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
41·5	56·5	77·7	65·7	60·3

SINGAPÚR, in the Straits of Maláka.

Latitude North.	Longitude East Green.	Height.
1° 18′	103° 53′	L.a.L.S.

1820-25. DAVIS. Journ. As. Soc., II., p. 428. — 6; 12; 6.

1839-40. TRAVELLI; SILLIMAN's Am. Journ., XXXXIV., p. 49.

1841-45. ELLIOT. Hourly observations; but the instruments seem partly to have been within, partly outside of, the observatory. They were most carefully calculated by Col. JACOB. Published at Madrás, 1850. I added a correction of + 0·6 determined by Col. JACOB, but not yet applied, since the instrument was received too late at Madrás.

1859. Parl. San. Rep., Vol. II., p. 595; left out as incomplete.

Months	1820	1821	1822	1823	1824	1825	1839-40	1841	1842	1843	1844	1845	General mean.
	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	Mean of the month.	
Jan.	77·5	77·1	79·8	78·1	79·7	78·6	79·1	78·5	79·9	78·8	78·9	79·6	78·7
Febr.	78·3	79·6	80·7	78·8	80·6	83·7	79·0	79·7	80·3	80·9	79·3	80·2	80·1
March	79·4	80·2	80·8	79·7	80·7	81·6	79·8	79·6	81·0	81·9	80·7	81·2	80·5
April	80·8	79·1	81·3	81·1	82·2	81·8	80·3	81·1	81·2	81·7	81·2	81·1	81·1
May	82·6	82·2	81·5	81·2	81·2	82·0	80·8	81·9	82·0	82·6	81·4	82·8	81·8
June	82·1	81·9	82·1	81·5	79·0	82·8	81·2	82·2	82·4	82·0	81·9	82·7	81·8
July	82·9	81·9	81·8	81·8	83·8	80·7	80·9	83·1	82·6	81·4	81·0	81·9	82·0
Aug.	82·2	81·3	81·4	81·3	82·4	80·0	79·6	81·0	81·3	81·7	80·9	82·8	81·3
Sept.	80·0	80·2	81·8	82·0	81·8	80·5	79·9	81·9	81·4	82·0	80·9	80·1	81·0
Oct.	80·2	81·2	81·6	81·0	81·3	81·2	80·5	81·4	80·6	80·8	80·8	80·9	81·0
Nov.	79·3	80·8	80·7	79·3	80·2	81·3	78·7	80·8	80·5	80·3	79·9	79·8	80·2
Dec.	77·8	79·6	78·3	80·1	78·4	79·4	79·0	80·1	79·9	80·2	79·6	78·7	79·3
Year	80·2	80·4	81·0	80·5	80·9	81·1	79·3	80·6	81·1	81·2	80·5	80·9	80·7

Isolated months (means), included. 1840: Nov. 81·1. 1841: Jan. 77·8; Febr. 79·8.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
79·4	81·1	81·7	80·7	80·7

Tavái.

Latitude North.	Longitude East Green.	Height.
14° 7′	98° 18′	L. a. L. S.

1852-54. Walter. SR.; 10; 4; SS.

Schlagintweit, "Met. Mscr.," Vol. 6.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	62·9	83·8	73·3	71·5	87·1	79·6	67·6	85·9	76·7	76·5
February	70·9	87·2	79·0	71·9	86·5	79·2	72·5	88·2	80·3	79·5
March	73·5	87·6	80·5	74·9	88·4	81·6	72·9	88·7	80·8	81·0
April	76·4	87·6	82·0	77·4	90·3	83·8	76·5	87·6	82·0	82·6
May	77·3	85·9	81·6	78·0	85·1	81·5	77·5	86·1	81·8	81·6
June	76·7	81·8	79·2	76·3	81·5	78·9	77·1	82·2	79·6	79·2
July	75·8	81·9	78·8	76·4	80·3	78·3	76·3	81·2	78·7	78·6
August	76·1	81·2	78·6	75·9	81·7	78·8	76·4	80·5	78·4	78·6
September	75·6	80·4	78·0	75·1	81·6	78·3	75·1	79·4	77·2	77·8
October	73·6	86·8	80·2	75·7	83·6	79·6	74·3	83·7	79·0	79·6
November	72·2	87·8	80·0	76·8	84·6	80·7	....	....	(81·0)	80·6
December	68·3	85·6	76·9	71·9	84·7	78·3	....	....	(79·0)	78·1
Year	for 1852: 79·0			for 1853: 79·8			for 1854: 79·5			79·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
78·0	81·7	78·8	79·3	79·5

Thayetmyó, in Běrma.

Latitude North.	Longitude East Green.	Height.
19° 20′	95° 12′	260 feet.

1859, Jan. to Dec. Timins. Parl. San. Rep., Vol. II., p. 562.
April 1860 to March 1861. Henderson. Macpherson, Madrás Sanitaria Reports, 1862, p. 320.

Months.	1859			1860-61			General mean.
	Min.	Max.	Mean.	Min.	Max.	Mean.	
January	52·5	88·5	70·5	54	81	68	69·2
February	62·0	95·0	78·5	56	89	73	75·7
March	66·6	98·3	82·4	70	96	83	82·7
April	77·0	101·0	89·0	75	95	85	87·0
May	77·5	93·2	85·3	79	93	86	85·6
June	74·9	84·2	79·6	77	87	82	80·8
July	77·0	86·7	81·8	77	86	81	81·4
August	77·5	86·7	82·1	77	86	81	81·6
September	77·5	87·7	82·6	77	88	82	82·3
October	76·2	86·6	81·4	76	87	81	81·2
November	65·5	85·0	75·2	72	83	77	76·1
December	62·3	84·1	73·2	59	79	69	71·1
Year	for 1859: 80·1			for 1860-61: 79			79·6

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·1	85·1	81·3	79·9	79·6

TÓNGHU, on the Síttang river, in Bérma.

Latitude North.	Longitude East Green.	Height.
18° 56′	96° 57′	280 feet.

1859. GORDON, in Parl. San. Rep., Vol. II., p. 550.
1860. GORDON. MACPHERSON, Madrás Sanitaria Reports, 1862, p. 334.

Months.	1859			1860	General mean.
	Min.	Max.	Mean.	Mean.	
January	57	82	69·5	68·5	69·0
February	63	90	76·5	75·5	76·0
March	70	90	80·0	83·4	81·7
April	80½	98·6	89·6	84·3	86·9
May	78·0	90·8	84·4	84·1	84·3
June	77 6	83·8	80·7	80·9	80·8
July	76·8	84·0	80·4	79·7	80·0
August	76·5	84·9	80·7	80·4	80·5
September	75·9	85·6	80·8	81·5	81·2
October	75·0	86·4	80·7	73·8	77·2
November	68·9	83·9	76·4	78·7	77·5
December	65·9	82·2	74·0	70·4	72·2
Year	for 1859: 79·5			1860: 78·4	78·9

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
72·4	84·3	80·4	78·6	78·9

ÁDEN, fort on the peninsula at the southern end of the Red Sea.

Latitude North.	Longitude East Green.	Height.
12° 46′	45° 15′	187 feet.

A. Means from E. E. SCHMID's "Meteorologie," p. 360.

B. Means for 1859 from the Parl. San. Rep., Vol. II., p. 846. The latter being throughout warmer, and no details about the place of the instruments and about the observations being given, I did not take the mean of the two series.

A. Mean of the months.

January	72·5	May	84·9	September	84·9
February	73·4	June	85·5	October	83·3
March	76·8	July	83·3	November	78·6
April	80·6	August	81·5	December	77·2

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
74·4	80·8	83·4	82·3	80·2

B. Mean of the months.

January	76	May	90	September	89
February	78	June	94	October	81
March	83	July	93	November	82
April	87	August	93	December	76

THERMAL TYPES OF THE YEAR AND THE SEASONS.

THE ISOTHERMAL LINES: Year, cool season, hot season, rainy season, autumn.
Thermal anomaly for India.
Statistical thermal tables.

THE ISOTHERMAL LINES.

The distribution of temperature over the surface of India, independent of the local modifications by height, is best shown by the form of its isothermal lines; they were made the object of the second and third of my physical plates.

In reference to the geographical details, I have limited myself to the principal river-systems; and to avoid interfering with the distinctness of the isothermal lines, the names of the stations, as well as the Indian mountain-systems, are left out; for the means of the year, the Archipelago and countries to the north-east of it are added, on a smaller scale.

The position of the stations, latitude and longitude being given everywhere, can be easily found on our route-map, where only the names of some of the smaller stations had to be left out. I used MERCATOR's projection, since the rectangular position of the lines of latitude and longitude in a chart facilitates the judging of the relative form of the isothermal lines, and it allows one to employ with it, for comparison, any analogous extended over a larger surface or representing the neighbouring countries; besides, in the tropical regions the increase of the dimensions with latitude does not much affect

the resulting forms. The four smaller maps of the seasons are arranged so as to present a cyclic aspect, those in proximity following in the chronological succession. For comparison with the globe the monthly isothermal lines, with the additional alterations for these parts of the tropics, are reduced from DOVE's maps.[1]

The unit of 1° Fahr. was made the basis—a unit considerably smaller than those hitherto employed; and although its use presented many an unexpected difficulty, yet it was finally made to include the principal provincial modifications; the local effect of height being kept from interfering with the thermal aspect by applying, for the reduction to the sea-level, the elements "of decrease with elevation" mentioned above.[2] The annual variation in the tropics being altogether included in more narrow limits than in higher latitudes, I found it sufficient to give the types only of the seasons, instead of entering into representations on the same large scale for each single month.[3] Great attention had to be directed to the parts of the maps where the lines have to be contiuued over the seas. Here the principal physical conditions were found to be the following: *a*) the depression in the easterly direction was common to all the periods represented, and *b*) also in the cool season, the land showed itself *warmer* than the surrounding seas; whilst in most parts of the higher latitudes the seas are comparatively warmer in winter, most distinctly where *favoured* by marine currents. From March to October the Indian peninsula marks itself so powerfully as a region of predominant effect of tropical insolation—quite analogous to the influence which we had found to be exercised by its burnt soil upon the lines of total intensity of magnetism—that the isothermal lines over the ocean obtain forms nearly parallel to the lines of the shores; in consequence, the sea-breezes in the bay of Bengál are, as was to be expected, more powerful and more refreshing along its western than on its eastern shore; altogether, when analysed in detail in reference to the modifications presented in the course of the annual variation, the tableaux of the isothermal lines in these tropical regions allow one to recognise most easily their connexion with the form[4] of the land. As another characteristic feature I must

[1] Monatsberichte der Berl. Acad., Nov. 23, 1848.

[2] See pp. 137-140. I must allude here also to the circumstance, that the inequality in the decrease of temperature with height in different localities must make the reductions to the level of the sea somewhat arbitrary, here, as everywhere; the variation, however, is not great enough to materially modify the construction of the isothermal lines.

[3] On a smaller scale it is seen on the monthly maps of the globe.

[4] In Europe modifications of climate considerably more variable are met with, but at the same time included altogether within much narrower limits. MARTINS, in his clever work: "Des Climats de la France," &c., distinguishes five types for France alone: "le climate Vosgien, Séquanien, Girondin, Rhodavien, et Provençal."

add, that not only the type of the lines changes completely from the cool to the hot and rainy seasons, but that during the latter even *new isothermal regions of heat* become apparent from the southern parts of the Pănjáb down to Sindh, which we may certainly expect to remain, if ever traced in other regions again, spots of the very greatest heat on our globe.

In drawing the lines, I made these distinctions: besides the lines being dotted where they pass the regions of High Asia, the "thermal equator" is also distinguished, its line being a broken one. In consequence of the great difference in latitude between the western and the eastern end of the Himálaya, the curves extend along the western margin of the map from 5° to 35° of latitude; along its eastern margin only from 5° to 30°. For the period corresponding to our summer, I was enabled to carry on the isothermal lines for Central Asia somewhat further to the north, in consequence of our personal stay in these regions.

The eastern part in the higher latitudes of the map is throughout cooler than the western part, as shown in the following table, where the numerical values are given for the two borders of India, the difference in latitude amounting here to 5° between the NW. and NE.

		Warmest isothermal line.	Minimum in the NW.	Minimum in the NE.
	Year	84° Fahr.	73° Fahr.	73° Fahr.
Seasons.	December, January, February	80 ,,	57 ,,	60 ,,
	March, April, May	90 ,,	72 ,,	73 ,,
	June, July, August	92 ,,	89 ,,	81 ,,
	September, October, November	82 ,,	75 ,,	74 ,,

The isothermal lines of the year already very decidedly show the influence of the topographical form of the Indian peninsula on the increase of the mean temperature: in the southern parts they follow the contours of the shores, or obtain forms evidently in connexion with them; in the northern part these lines are raised to the extent of a difference of five degrees of latitude where they pass over the central axis of India, this region being warmer than those of Afrika in equal latitude. At the same time, southern India presents one of those insular regions of greatest heat which are

connected with each other by the thermal equator; the Indian archipelago shows us the next of these regions which follows to the east.

When comparing the seasons, our attention is drawn first of all to the unusually great *variety* of the four types, whilst in many of the more western regions of the tropics we see that it is more the numerical value of the lines which is changed than the type of their forms. In the mean of the year the "*thermal equator*," a line of variable value but connecting the hottest regions all round the globe, touches the western coast of India in a latitude of 17°, and descends along its central axis to Ceylon (which it leaves in an easterly direction at $5^1/_2$°). This is not an isolated modification; the thermal equator is in the mean several degrees to the north of the terrestrial equator, in the western as well as in the eastern hemisphere.[1]

In India and the Indian archipelago the thermal equator runs still to the south of the geographical one for all the three months of the cool season; in consequence of the distribution of land and sea the temperature of the winter of the northern hemisphere is the cooler one also for our globe in general, notwithstanding that the distance of the earth from the sun is considerably smaller at this period than in our summer. In the season corresponding to our summer, from July to August, we see the thermal equator has been raised to the latitude of 32° N. This period of the year is, for the greater part of the map, the rainy season, though for the region in the north-west it is the very season of an absolute maximum of heat. These variations have the more importance, as the territory here represented has a surface considerably larger than might be expected, perhaps, from the extent of European empires. The distance from the Bay of Biscay to the Caspian Sea can be considered as about equal to the difference in longitude of the borders of this map; whilst 30° of latitude, referred to European regions, might be compared with the distance from the southern shores of the Mediterranean to St. Petersburg. The superficial area of India alone is 1,500,000 English square miles.

As the general means all over India, from the Pănjáb down to Ceylon, we obtain:

Year $80^1/_2$; cool season 69; hot season 88; rainy season 88; autumn 79. The cause of the mean of the rainy season's not appreciably differing from that of the hot season is to be sought for in the very considerable rise of temperature in the north-

[1] The *mean* of the northern hemisphere is estimated to be 5°·6 Fahr. warmer than the southern one.

west. Wherever we pass the tropic of Cancer the character of the group June, July, August soon shows itself as the "summer" of the northern hemisphere; in the eastern regions at even a much lower latitude; but here the numeric difference is smaller; the mean in Assám is 82°, whilst that of the "Indian" hot season preceding—March, April, May—is 74° Fahr.; in the Pănjáb the respective numbers are 92 and 78.

In Southern India the distance from the shores has an influence on the increase of the mean of the year, materially concealing most of the minor elevations in the interior.

The cool season. Even this period already shows traces of the increase of temperature in the interior of the country when compared to surrounding seas; the influence of the sun is of a tropical character also in winter, but, as was to be expected, it is, comparatively speaking, but little felt during this season in the provinces at some distance to the north of the equator, on account of the southern position of the sun. In the region beyond the tropics the hibernal influence of continents, compared to that of the seas, causes depression of temperature. In reference to the Pănjáb, it must be further added that we have here a great number of stations for which the actual temperature is still lower than the values represented by the isothermal lines, though the latter had to be reduced already to the level of the sea. Local accumulation of cold air connected with the form of the ground, and, throughout the season, a sky unusually clear, so favourable to nocturnal radiation, may be mentioned as the principal causes.

A quite exceptional depression occasionally follows the course of the rivers. Also all along the foot of the Himálaya gusts of cold wind are not unfrequent; these at first follow the valleys; but, as we shall have sufficient data to prove, the temperature along the Himálaya finally becomes decidedly cooler in Hindostán and Bengál, even for the mean of the year.

The decrease of temperature with latitude is by far most rapid in the cool season.

The more rapid decrease of temperature with latitude in winter is a phenomenon also observed when higher latitudes are compared. In July and August, even for means based upon periods of five days only, London, Berlin, Petersburg, Archangel, Irkutzk, and Jakutzk, do not differ more than 4° to 5° Fahr.; Madrás is 22° Fahr. warmer than London: but in winter it is 40° Fahr. warmer; Irkutzk, compared with London, is

45° Fahr. colder in winter, Jakutzk 82° Fahr. Absolute extremes would show differences greater still.

The thermal equator is in the southern hemisphere, in a latitude of 5° to 8°.

The second period of the year (March, April, and May), which is generally called the hot season all over India, also in its north-western parts, shows a remarkable difference in the type of the curves when compared to the cool season. No region in higher latitudes can be found varying so greatly in type; the influence of the topographical forms of the peninsula has become now considerably more apparent. The thermal equator enters the western border of the map already at an elevation of 24° of latitude, passes through a central region of maximum temperature exceeding 90°, and descends from thence directly to the south, to the very southern end of India. Great dryness is combined in this period with the high temperature, and is an important element for making its difference from the other seasons still more apparent: hot winds conceal the sky for days, and the glare radiating from the ground is not less oppressive than the suspensions of dust in the atmosphere; but it would be erroneous to expect, as it might appear rather probable, that, in consequence of the dryness, the heat is felt the more by the human organism. Though the central parts, compared to the shores of the sea, show a rapid increase of temperature with the progress towards the interior, I must add that, on account of the moisture being greater along the shores, not only the heat is there more close and more disagreeable but also its influence on the health, especially of Europeans, is decidedly still more unfavourable. For the coasts, and for the interior of tropical India, these months remain the period of the year which includes the highest means, and also the greatest heat of single days. The central and eastern regions of the Himálaya, cooling a little in winter, have now no more any durable influence, not even in the tarái at its very foot; also the dotted lines connecting so directly the temperature of the Pănjáb with those of Assám, in perfect conformity with the lines running down along the Ganges, corroborate it. Only some parts of Bengál, such as Tirhút, have, exceptionally, extremes somewhat less excessive, but neither do these appreciably differ in the mean of the season.

The third period (June, July, and August) is, for the greatest part of India, the rainy season; its setting-in is connected, most distinctly in Central India, with a

rapid sinking of temperature; in most of the other parts of India the difference is chiefly remarkable between the *monthly* means of May and June, whilst the mean of the two respective *seasons* does not differ much, or even increases in the rainy season, as already in the latitude of Ágra, in Hindostán, and all over Assám and the neighbouring countries. In latitudes near the tropic it is not unfrequent to observe the absolute extremes in July, when a moist but transparent atmosphere coincides for a short period with the greatest height of the sun. Also nearer to the shores a beneficial cooling is felt less distinctly than in Central India. The dampness has increased, too, together with the clouds, and makes, in the shade at least, the heat the more steamy. The power of insolation being now broken by a sky nearly permanently clouded, must be considered as the principal cause why the beginning of this season is in general considered as a welcome period. For the health, however, it is less favourable; dyspetic complaints and fevers are frequent throughout in the latter part of this season. In the Pănjáb, and partly also even in the north-west provinces of Hindostán, this period has no longer the character of a rainy season. The precipitation takes the form of our summer rains with thunder-storms, and also the amount of precipitation most rapidly decreases towards the north-west.

At the same time the meteorological observations showed for these very regions a maximum of temperature which I did not expect, not only on account of the number of stations formerly existing being not very great, but also since I heard from the inhabitants, the Europeans as well as the natives, no unusual complaints about the heat being much greater than in other parts of India. Nevertheless these provinces include a region for which the mean temperatures during the three months exceed 92°, and must therefore be considered as one of the very hottest regions of our globe; besides, we must further take into consideration that clear days are not unfrequent, during which the purity of the sky is not even modified, as it was in the period preceding, by dust suspended in the atmosphere. Therefore the absolute maxima in the shade are also higher here than in any other region of India.

I may further draw attention to the fact, that for this region also the non-periodic variations of temperature—that is, the variations between different years—have become much greater than we find them to be in the more southern tropical part of the territory examined. The thermal equator enters the west of the map at the latitude of 32°, and only leaves the Indian peninsula near Ceylon, in an easterly direction.

The influence of height in the Pănjáb is not very considerable at this season, and the curves I have drawn remain for some stations even still a little below the respective means; but in the other regions, where the character of the "rainy season" prevails, the decrease of temperature with height is more rapid than during any other part of the year.

Autumn (September, October, November) is the only one of the tropical seasons which here shows a very regular form of its curves, and a very slow decrease of temperature with latitude. In the mean of the year the difference of 1° Fahr. frequently corresponds to a difference of 120 miles in latitude; in autumn the latitude between Ceylon and the Pănjáb only produces a decrease from 5° to 6° Fahr. It is not less remarkable for this season that in most regions, as in those along the banks of the larger rivers, the drying up of vast surfaces formerly inundated is the cause of most deleterious miasmatic vapours; but in the Pănjáb, and in the hilly regions along the Brahmapútra and in Central India, where these dangerous modifications of the atmosphere are not to be feared, this season frequently approaches the mild and refreshing character of the regions of southern Europe.

The month of October shows, in many regions where the sky is very clear, a remarkably high temperature.[1]

THERMAL ANOMALY FOR INDIA.

The thermal conditions of India may be compared with those of the globe also in reference to *thermal Anomaly*, a principle first enounced by Dove,[2] by showing the difference of the temperature at a given locality from the mean of these latitudes all round the globe. Lines connecting such values, "the isanomalous lines," show therefore which parts of the globe, in the different seasons, must be considered as comparatively too cold or too warm.

The thermal anomaly for these regions is included in very narrow limits: the Indian Archipelago in its central parts is a little warmer than the mean of the corresponding latitude throughout the year; India is below the corresponding value only in December, and in its western parts also in January; the difference, however, does

[1] Compare the remarks on the influence of the distance from the sun in connection with insolation, p. 51.

[2] "Verbreitung der Wärme," Berl. Acad., 1852.

not exceed 5° to 6° Fahr.; during all the other months its deviation is positive; viz., compared to the globe in general, it is too hot even for its latitude. From May to July first its central, and soon still more its north-western regions, show a "positive" thermal anomaly, viz., difference *exceeding* the mean of the same latitude all round the globe, by 11° to 12° Fahr. The Indo-Chinese Peninsula is below the mean from November to March, above it from April to October.

To facilitate the analysis and comparison, I added *statistical thermal tables*, showing the different stations arranged for practical comparison according to the temperature actually observed, including the influence exercised by height and local modification. The difference of these values from the isothermal line in the same latitude and longitude may therefore be considered as the definition of the *local* thermal anomaly, and may occasionally assist in answering various practical questions.

Though here, as in the construction of the lines, I did not enter into a comparison of the means for every month, but only for the seasons and the year, the decimals used in fixing the succession of the places in the tables might have been limited to $^1/_2$°, in reference to positive accuracy, had not the retaining of the numbers just as they were obtained the advantage of facilitating the references to the provincial tables preceding. Those tables showed the temperature of every station hitherto observed; the isothermal lines present the comparison of these values, exclusive of height, and their connexion with the analogous conditions of the globe; the remaining consideration, viz. a comparison inclusive of the height and the local modifications, is the object of the statistical tables. We see at a glance which stations are hottest in the different seasons, and which are the temperatures most frequently predominant. As was to be expected from the isothermal lines, the absolute heat is met with at the stations in the north-western parts—Pănjáb, Sindh—in the period from June to August; Déra Ismáel Khan with a mean of 94°, Jacobábad with 96° Fahr., concluding the list; how different from their position in the other seasons!

(India and the Archipelago.)

STATISTICAL

MEANS OF

51·8	Gunong Merapi.
53·2	Dodabétta.
55·9	Utakamánd.
58·5	Malabar Hill station.
6	Nurélia.
59·9	Mount Zion.
60·3	Shanghái. Tikokur.
4	Jakunări.
61·5	Upper Salak.
9	Koterghérri.
62·5	Cherrapúnji.
65·1	Jakutálla.
2	Átăre Măllē.
66·1	Lower Salak.
4	Kunúr.
6	Mahabaléshvar.
67·1	Wellington.
2	Manantvádi.
3	Shevarái.
69·1	Mahabaléshvar-Păchgăni.
8	Purandár.
9	Kánton.
70·3	Ábu.
5	Bádula.
7	Săráuli.
71·3	Merkára.
4	Raulpíndi.
6	Govindgárh.
8	Kálsi.
72·1	Naushĕra. Sialkŏt.
2	Láya. Makáo.
3	Jhílum.
5	Báitul.
8	Kándi. Ramandrúg.
9	Pesháur.
73·0	Naziruaghăt.
1	Firózpur.
2	Bánnu. Dibrugárh.
3	Jălhándar.
4	Hazaribágh. Tézpur.
8	Déhli.
9	Belgáū.
74·0	Sibsăgar. Golaghát.
2	Bangalúr. Hoshiárpur.
3	Ămbála.
4	Erinpúra.
6	DĕraGházi Khan.
74·7	Kohăt.
8	Dhărvár. Muradabád.
75·0	Satára. Lahór. Shăhpur.
1	Shahjehănpur. Goalpára.
2	Măngaldái. Nakódar.
3	Hong-Kong.
4	Peredénia. Saháranpur. Vazirabád. Nărsínghpur.
5	Bógra. Bărpétah.
6	Kachár. Mozăfarpúr.
7	Sehór. Tirhút.
8	Gohátti. Míră̆th.
76·0	Baréli. Bijnúr. Chittagóng. Hánsi. Kartárpur. Maimansíngh. Măteli.
76·1	Bhūj. Nazirabád.
2	Kishánpur. Silhét.
3	Dĕra Ismáel Khan. Jáblpur. Púna. Típpera.
4	Barisál.
5	Étava.
6	Buitenzorg. Fătigárh. Chápra.
7	Koimbatúr. Samulkóttah.
8	Multán. Rángpur. Ságar.
9	Khervára. Kólapur. Părnea.
77·0	Kírki. Máhu.
1	Fáridpur. Sándove.
3	Gorákhpur. Húgli.
4	Mainpúri. Sikănderabád.
5	Bĕrhampur. Pátna. Serúr. Noakólli. Nímăch.
6	French Rocks.

THERMAL TABLES. *(India and the Archipelago.)*

THE YEAR.

77·7	Kărráchi.
8	Dáinajpur.
	Rámpur Bólea.
9	Chaiabásso.
—	—
78·0	Ahmadnâger.
	Bākúra.
	Mírzapur.
1	Ágra.
2	Azimgărh.
3	Calcutta.
	Dísa.
	Kánhpur.
4	Áva.
	Dháka.
	Jessór.
	Pábna.
6	Kălâdghi.
	Máthra.
7	Barrakpúr.
8	Lăkhnáu.
	Naugóng.
9	Bhăgalpúr.
	Tónghu.
—	—
79·0	Dămdám.
1	Akyáb.
	Batávia.
2	Dápuli.
3	Pháltan.
	Rangún.
	Triyándrum.
79·4	Gáya.
5	Manilla.
	Taváí.
79·6	Ajmír.
	Jálna.
	Jhánsi.
	Murshedabád.
	Thayetmyó.
7	Chandernagúr.
	Kyuk-phyú.
	Vingórla.
8	Birbhúm.
9	Banjuvángi.
	Benáres.
—	—
80·0	Chunár.
1	Hamírpur.
	Pátlam.
	Punamáli.
2	Áden.
	Bellári.
	Kolómbo.
	Lohát.
3	Bombay.
	Hărihár.
	Púri.
4	Bărdván.
	Dhúlia.
	Palembáng.
	Rajkŏt.
	Shólapur.
5	Baróda.
	Kŏchin.
80·6	Sálem.
7	Gálle.
	Singapúr.
8	Kananúr.
	Penáng.
9	Jacobabád.
—	—
81·0	Allahabád.
	Bíjapur.
	Gálle.
	Kokonáda.
	Mangalúr.
	Port Blair.
1	Anjarakándi.
	Bangkók.
3	Kalikât.
4	Trinkonomalí.
5	Árkot.
	Chittúr.
	Haiderabád, Dékhan.
	Haiderabád, Sindh.
6	Nágpur.
9	Orái.
	Sámarang.
	Surát.
—	—
82·0	Gantúr.
	Gházipur.
	Madrás.
1	Nellúr.
2	Battikótta.
4	Karikál.
	Rajamándri.
5	Kádalur.
9	Vizagapatám.
—	—
83·3	Ahmadabád.
	Kâdapa.
	Kărnúl.
	Pallamkóttah.
5	Trinkonomalí.
8	Masulipatám.
—	—
84·0	Labuán.
5	Pondichéri.
6	Tinevélli.
7	Trichinápalli.
8	St. Thomas Mount.
9	Madúra.

(The cool season.)

STATISTICAL

MEANS OF DECEMBER,

40·9 Chúsan.

41·5 Shanghái.

51·3 Dodabétta.
5 Naushéra.

52·1 Utakamånd.
5 Jhílum.
8 Sialkōt.

53·1 Láya.
2 Bånnu.
4 Dēra Ismáel Khan.
9 Cherrapúnji.

54·0 Raulpíndi.
2 Govindgårh.
4 Firózpur.
5 Erinpúra.
8 { Kánton.
Săráuli.

55·0 Shåhpur.
1 Pesháur.
5 Dēra Ghází Khan.
6 Ludhiána.

56·3 Kohåt.
5 Hoshiárpur.
9 Lahór.

57·0 { Jălhåndar.
Nurélia.
1 Vazirabád.
2 Ambála.
3 Jakunări.
5 Déhli.
6 Nakódar.
7 Mount Zion.

58·0 Bijnúr.
3 Hánsi.
4 Sahåranpur.
9 Muradabád.

59·0 Multán.
1 { Koterghérri.
Shahjehánpur.
4 Makáo.
5 { Kartárpur.
Míräth.
6 Kálsi.

60·0 { Jakatálla.
Nazirabád.
1 Javánpur.
3 { Étava.
Golaghåt.
8 { Aligårh.
Báitul.
Mozăfarpúr.
60·9 Fătigårh.

61·2 Chunár.
3 Kunúr.
4 { Ágra.
Tirhút.
6 { Baréli.
Tézpur.
9 Manantvådi.

62·0 { Lăkhimpúr.
Mainpúri.
Naziruaghåt.
1 Kánhpur.
2 { Chápra.
Dibrugårh.
Sibsågar.
4 { Hazaribágh.
Nărsínghpur.
5 Jacobabád.
6 Sultánpur.

63·0 { Mírzapur.
Pátna.
5 { Jáblpur.
Khervára.
Måthra.
6 Atăre Mállē.
7 Naugóng.

64·0 Pårnea.
1 { Azimgårh.
Sehór.

64·3 { Ábu.
Bógra.
Gorákhpur.
Lăkhnáu.
4 Chandernagúr.
5 { Bărpétah.
Mahabaléshvar.
Ságar.
6 Maimănsíngh.

65·0 Shevarái.
1 { Kachár.
Kishánpur.
2 Benáres.
3 { Ajmír.
Bhūj.
Goalpára.
Húgli.
5 { Bērhampur.
Hong-Kong.
6 { Allahabád.
Gohátti.
7 Wellington.
9 Naugóng.

66·0 { Dáinajpur.
Jessór.
Kărráchi.
1 Rángpur.
3 { Bākúra.
Dísa.
Jhánsi.
Típpera.

THERMAL TABLES.

(The cool season.)

January, February.

66·4 Barisál.
Bhāgalpúr.
Chittagóng.
Gáya.
5 Chunár.
6 Nímăch.
7 Măngaldái.

67·1 Murshedabád.
Rámpur Bólea.
3 Mahabaléshvar-Pāchgấni.
5 Hamírpur.
6 Chaiabásso.
Dháka.
Purandắr.
Silhét.
7 Fărídpur.
Noakólli.

68·0 Gházipur.
Pấbna.
1 Calcutta.
5 Bádula.
8 Áva.
Orái.
9 Barrakpúr.

69·2 Dămdám.
5 Birbhúm.
9 Bărdván.

70·0 Haiderabád, Sindh.
Sikăndarabád.
4 Merkára.
6 Máhu.
Rajkŏt.
7 Sándove.

71·0 Rumandrúg.
2 Barŏda.
3 Samulkóttah.
4 Púna.
5 Púri.
Sattára.
6 Kándi.
7 Belgấũ.
Máteli.

72·0 Dhărvár.
1 Thayetmyó.
3 Kírki.
Serúr.
4 Tónghu.
6 Dhúlia.
8 Ahmadnấger.
9 Nágpur.

73·0 Kólapur.
1 Koimbatűr.
2 Kăládghi.
3 Ahmadabád.
8 Kyuk-phyú.
Peredénia.

74·2 Jálna.
3 Árkot.
4 Áden.
7 French Rocks.
Súrat.
8 Vizagapatám.
9 Phåltan.

75·0 Haiderabád, Dékhan.
Kådapa.
1 Belléri.
4 Dápuli.
6 Rangún.
7 Bombay.
Chittúr.
Rajamándri.
8 Nellúr.
Shólapur.
9 Buitenzorg.
Kokonáda.

76·0 Hărihár.
6 Sálem.
7 Madrás.
9 Kådapa.
Karikál.

77·2 Gantúr.
4 Påtlam.
5 Bangkók.
6 Kádalur.
Manilla.
7 Bíjapur.

78·0 Tavái.
2 Vingórla.
6 Punamáli.
Trivándrum.
7 Masulipatám.
8 Kolómbo.
Kărnúl.

79·1 Pallamkótta.
2 Batavia.
Battikótta.
3 Ross Island.
4 Lahát.
Singapúr.
5 Gálle.
7 Penáng.
8 St. Thomas Mount.
9 Palembáng.

80·0 Kananúr.
Kŏchin.
Trinkonomalí.
1 Banjuvángi.
3 Madúra.
5 Mangalúr.
6 Anjarakándi.
7 Sámarang.
9 Kalikắt.

81·3 Tinevélli.
5 Trichinápalli.
9 Pondichéri.

(The hot season.)

STATISTICAL

MEANS OF MARCH,

56·5 Dodabétta.
Shanghái.

59·4 Utakamánd.
6 Nurélia.

61·6 Koterghérri.

62·4 Jakunári.

63·0 Mount Zion.

64·1 Cherrapúnji.

66·6 Wellington.

67·4 Átăre Mállē.
7 Jakatálla.

68·0 Kunúr.

69·8 Kánton.

70·0 Shevarái.
2 Bangalúr.
7 Bádula.

71·3 Makáo.
4 Manantvădi.
6 Raulpíndi.

72·2 Pesháur.
4 Naushéra.
8 Mahabaléshvar.
Naziruaghăt.

73·0 Govindgărh.
3 Bánnu.
Hong-kong.
7 Dibrugărh.
Sibságar.
8 Kālsi.
Lăkhimpúr.
9 Maghanássi-Hill.

74·0 Jhílum.
1 Kándi.
3 Tézpur.
Sărăuli.
Sialkŏt.
9 Jălhándar.

75·1 Bărpétah.
3 Ábu.
4 Láya.
6 Merkára.
7 Firózpur.
Măngaldái.
8 Golaghát.

76·0 Mahabaléshvar-Păchgănni.
Sháhpur.
5 Naugóng.
6 Ludhiána.
7 Buitenzorg.
8 Kartárpur.

77·1 Kohăt.
Kachár.
2 Multán.
Vazirabád.
3 Goalpára.
4 Gohátti.
Hoshiárpur.
Peredénia.
Shahjehănpur.
6 Dĕra Gházi Khan.
Nakódar.
8 Máteli.
Silhét.

78·0 Lahór.
Maimănsíngh.
3 Ambála.
Bógra.
Ramandrúg.
4 Purandár.
5 Ásni.
Déhli.
Dĕra Ismáel Khan.
7 Baréli.
9 Belgáū.

79·0 Gugéra.
1 Barisál.
Saháranpur.
3 Dharvár.
5 Bangalúr.
Satára.
6 Hazaribágh.
Típpera.
7 Rángpur.
8 Chittagóng.
Fărídpur.

80·0 Báitul.
Kărráchi.
Míräth.
Muradabád.
Sándove.
3 Párnea.
4 Batavia.
Púna.
6 Banguvángi.
Narsínghpur.
Koimbatúr.
7 Mozăfarpúr.
Rangún.
8 Áden.
Javánpur.
Lahát.
9 Manilla.
Palembáng.

81·0 Bijnúr.
1 Mérgui.
Ross Island.
Singapúr.
Tirhút.
3 Erinpúra.
4 Noakólli.
5 Bĕrhampur.
Gálle.
Vingórla.
6 Nazirabád.

THERMAL TABLES.

(The hot season.)

April, May.

81·7	Kírki.
	Tavái.
8	Bhūj.
	Kolómbo.
	Rámpur Bólea.
9	Sámarang.
—	—
82·0	Áva.
	Gorákhpur.
	Kólapur.
	Punamáli.
	Trivándrum.
2	Calcutta.
	Étava.
4	Pátlam.
6	Akyáb.
	Fătigårh.
	Jessór.
7	Dháka.
	Måthra.
	Påbna.
8	Dápuli.
9	French Rocks.
	Pátna.
—	—
83·0	Bombay.
	Mírzapur.
1	Barrakpúr.
	Labuán.
	Sehór.
3	Samulkóttah.
83·4	Aligårh.
5	Nellúr.
	Naugóng.
	Săgar.
6	Dămdåm.
7	Kőchin.
8	Chápra.
9	Bangkók.
	Jáblpur.
—	—
84·0	Húgli.
	Púri.
	Serúr.
	Sikăndarabád.
1	Azimgårh.
	Sálem.
2	Madrás.
3	Ahmadnåger.
	Anjarakándi.
	Battikóta.
	Máhu.
	Tónghu.
4	Bākúra.
	Kananúr.
	Kishánpur.
5	Monghír.
	Murshedabád.
6	Arkot.
	Kokonáda.
	Phåltan.
	Rangún.
84·7	Chaiabásso.
	Gantúr.
	Jacobabád.
	Kalikát.
	Pondichéri.
8	Trinkonomalí.
9	Mangalúr.
—	—
85·0	Chunăr.
	Hánsi.
1	Dísa.
	Kyuk-phyú.
	Thayetmyó.
2	Kádalur.
	Karikál.
	Nímăch.
3	Kánhpur.
4	Ágra.
5	Gáya.
6	Birbhúm.
	Pallamkótta.
7	Bărdván.
	Shólapur.
8	Lăkhnáu.
	Rajkőt.
9	Beávr.
—	—
86·0	Dáinajpur.
	Haiderabád, Sindh.
	Hamírpur.
1	Khervára.
	Rajamándri.
2	Bellári.
86·4	Chandernagúr.
5	St. Thomas Mount.
6	Ajmir.
7	Jálna.
	Mainpúri.
8	Hărihár.
9	Bhāgalpúr.
	Chittúr.
—	—
87·0	Jhánsi.
	Mazulipatám.
	Tinnevélli.
2	Bíjapur.
	Súrat.
3	Dhúlia.
5	Ghâzipur.
6	Vizagapatám.
9	Benáres.
—	—
88·0	Kălădghi.
3	Hushangabád.
	Madúra.
4	Trichinápalli.
8	Orái.
—	—
89·0	Barŏda.
1	Kådapa.
2	Allahabád.
5	Haiderabád, Dékhan.
	Kărnúl.
—	—
91·0	Ahmadabád.

(The rainy season.)

STATISTICAL

MEANS OF JUNE,

52·8 Dodabétta.

56·6 Utakamând.

59·3 Nurélia.

60·3 Mount Zion.

62·9 Jakunâri.

64·2 Mahabaléshvar.
7 Átâre Mállē.
Koterghérri.

66·5 Purandâr.
7 Mahabaléshvar-Pāchghânni.

67·7 Manantvâdi.
8 Merkára.
9 Cherrapúnji.

68·0 Jakatálla.
Shevarái.
3 Kunúr.
7 Wellington.

70·8 Bádula.

71·3 Ramandrúg.

72·3 Belgâū.
7 Abu.

73·0 Chendvár-Hill.
Kándi.
5 Dhărvár.

74·3 Bangalúr.
6 Satára.

75·8 Peredénia.

76·3 French Rocks.
Kólapur.
4 Buitenzorg.
8 Kírki.

77·0 Koimbatúr.
Máhu.
5 Púna.
6 Báitul.
Serúr.
7 Shanghái.

78·1 Kốchin.
3 Trivándrum.
4 Mangalúr.
5 Mérgui.
6 Ahmádnâger.
Hărihar.
7 Máteli.
8 Tavái.
9 Kananúr.

79·0 Batavia.
Sándove.
1 Anjarakándi.
Banjuvángi.

79·2 Sikăndarabád.
Vingórla.
3 Kyuk-phyú.
Rangún.
Samulkóttah.
4 Kalikât.
6 Hazaribágh.
7 Jálna.
8 Dápuli.
Kăládghi.

80·1 Kishánpur.
Manilla.
Palembáng.
Rangún.
2 Chittagóng.
Phâltan.
3 Lahát.
4 Tónghu.
8 Kolómbo.
9 Goalpára.

81·1 Belläri.
Pátlam.
2 Sámarang.
3 Akyáb.
Măngaldái.
Thayetmyó.
4 Nímăch.
5 Gálle.
Silhét.

81·6 Barisàl.
Bíjapur.
Húgli.
Típpera.
7 Bărpétah.
Sehór.
Singapúr.
8 Bombay.
Dáinajpur.
Penáng.

82·0 Kánton.
Tézpur.
1 Dibrugârh.
Naziruaghát.
2 Bángkók.
Fărídpur.
Khervára.
Sálem.
3 Bógra.
4 Noakólli.
Rângpur.
5 Kachár.
Nărsínghpur.
6 Tirhút.
Gohátti.
7 Bhūj.
Nágpur.
Shólapur.
8 Maimănsíngh.
Makáo.

83·0 Dhúlia. [Dékhan.
Haiderâbád,
1 Jâblpur.

THERMAL TABLES. *(The rainy season.)*

JULY, AUGUST.

83·2	Sibságar.
3	Calcutta. Dháka. Kálsi.
4	Aden.
5	Barŏda. Dămdâm. Jessór.
6	Áva. Chaiabásso.
7	Battikótta. Golaghât. Rámpur Bólea.
9	Barrakpúr. Naugóng.
84·0	Kărnúl. Kokonáda. Punamáli.
3	Gantúr.
4	Pâbna.
5	Hong-Kong. Súrat.
6	Mozăfarpúr.
7	Săráuli.
8	Birbhúm.
9	Chittúr. Govindgârh. Púri.
85·1	Chápra. Rajkŏt.
85·2	Pârnea. Băkúra.
85·3	Bérhampur. Hushangabád. Kádalur. Pallamkótta.
4	Bhāgalpúr.
5	Dísa. Pátna.
6	Gorákhpur. Muradabád.
7	Bărdván. Trinkonomalí.
8	Erinpúra. Trichinápalli.
9	Karikál. Madrás. Murshedabád. Sítapur.
86·0	Kărráchi.
2	Jălhândar. Nazirabád.
3	Déhli. Kâdapa. Vizagapatám.
4	Gáya. Jhánsi. Pondichéri. Ságar. Tinevélli.
5	Kâdapa. Raulpíndi.
6	Árkot.
7	Azimgârh. Beávr.
86·8	Baréli.
9	Ajmír. Fătigârh.
87·2	Benáres. Lăkhnáu.
3	Madúra. Máinpúri.
4	Étava. Naugóng.
5	Ambála. Monghír.
6	Mírăth. Nellúr.
7	Ahmadabád. Hoshiárpur.
8	Ghâzipur.
9	Masulipatám.
88·0	Jhílum. Mírzapur. Shahjehánpur. Sialkŏt.
1	Hamírpur.
2	Kánhpur.
3	Hánsi.
4	Ágra. Nakódar. Saháranpur.
88·5	Bijnúr. Chunúr. Dĕri. Kartárpur.
88·6	Firózpur.
7	Lahór.
8	Láya. Panipât.
9	Ludhiána. Mâthra.
89·0	Aligârh.
1	Allahabád.
3	St. Thomas Mount.
4	Chandernagúr.
6	Kohât.
8	Ásni. Pesháur.
90·1	Vazirabád.
2	Haiderabád, Sindh.
8	Bánnu.
9	Orái.
91·0	Gházipur.
1	Déra Ghâzi Khan.
92·0	Multán. Naushéra.
93·0	Shâhpur.
9	Déra Ismáel Khan.
96·3	Jacobabád.

(The Autumn.)

STATISTICAL

MEANS OF SEPTEMBER,

52·4 Dodabétta.

55·4 Utakamánd.

58·5 Nurélia.
7 Mount Zion.

59·1 Jakunári.

61·8 Shíllong.

64·1 Cherrapúnji.
7 Jakatálla.

65·0 { Mahabaléshvar.
Átare Mállē.
7 Shanghái.

66·3 { Mahabaléshvar-Pãchgåni.
Shevarái.
9 Purandår.

67·3 Wellington.
7 Manantvådi.
8 Chúsan.

68·0 Kunúr.
69·0 { Ábu.
Saráuli.

70·3 Kálsi.
6 Ramandrúg.

71·4 Láya.
5 Merkára.
8 Báitul.
9 { Bádula.
Hazaribágh.

72·3 Kándi.
5 { Naushéra.
Belgáū.
8 { Kánton.
Ságar.
9 Bangalúr.

73·0 { Déhli.
Samulkóttah.
4 Raulpíndi.
5 { Kălådghi.
Sialkőt.
7 { Firózpur.
Mainpúri.
8 Sehór.

74·1 { Déra Ghãzi Khan.
Satára.
2 Ambála.
3 Pesháur.
4 Govindgårh.

74·6 Dhărvár.
7 { Bhūj.
Dibrugårh.
Jhílum.
Muradabád.
8 { Peredénia.
Jáblpur.

75·0 Makáo.
1 Jalhåndar.
2 Hoshiárpur.
3 Kishánpur.
4 Bánnu.
5 Chápra.
6 { Bākúra.
Khérvara.
Kohát.
Máhu.
Tézpur.
8 { Máteli.
Saháranpur.
Shahjehánpur.
9 { Koimbatúr.
Narsínghpur.

76·0 { Erinpúra.
Fatigårh.
Kólapur.
Púna.
Serúr.
Sháhpur.

76·1 { Étava.
Golaghát.
Míråth.
Mozafarpúr.
2 Sikăndarabád.
3 French Rocks.
4 { Bijnúr.
Lahór.
5 Dísa.
6 Nazirabád.
7 Goalpára.
8 Ahmadnåger.
9 { Baréli.
Chaiabásso.
Javánpur.
Naziruaghát.
Nímăch.
Sibságar.

77·0 { Aligårh.
Bhagalpúr.
Vazirabád.
1 { Ágra.
Nakódar.
2 { Bíjapur.
Hushangabád.
Mangaldái.
Naugóng.
3 { Bógra.
Buitenzorg.
Kírki.
Shólapur.

THERMAL TABLES.

(The Autumn.)

October, November.

77·4	Silhét. Phåltan. Gohátti. Gorákhpur.
6	Kánhpur. Tirhút.
7	Chittagóng.
8	Dáinajpur. Jálna.
9	Batavia. Kachár. Típpera.
———	
78·0	Azimgárh. Bérhampur. Hong-Kong. Lăkhnáu. Mírzapúr.
2	Bellári. Húgli. Pårnea. Trivándrum.
3	Naugóng.
4	Baróda.
5	Chittúr. Haiderabád, Dékhan. Púbna. Pátna.
6	Dhúlia. Tónghu.
78·7	Barisál. Chăndernagúr. Dápuli. Farídpur. Hamírpur. Maimănsíngh. Monghír.
8	Jhánsi. Rámpur Bólea.
9	Sándove.
———	
79·0	Barrakpúr. Kărráchi. Orái.
1	Kartárpur.
2	Áva. Birbhúm. Gáya. Multán.
3	Benáres. Tavái.
4	Déra Ismáel Khan. Kokonáda. Kolómbo. Måthra. Noakólli.
5	Ajmír. Manilla. Nágpur. Rángpur.
6	Dămdăm. Pátlam. Sálem.
79·7	Calcutta. Hăribár. Punamáli.
8	Dháka.
9	Kananúr. Thayetmyó. Penáng. Vingórla.
———	
80·0	Banjuvángi. Chunúr. Haiderabád, Sindh. Jacobabád.
1	Bărdván. Kalikát. Mangalúr.
2	Kőchin. Lahát.
3	Akyáb. Anjarakándi. Gálle.
6	Árkot. Kyuk-phyú.
7	Púri. Bombay. Barpétah. Singapúr.
9	Bangkók. Karnúl. Palembáng. Rangún.
———	
81·0	Ahamadabád. Gházipur. Murshedabád.
2	Kådapa.
3	Madrás. Súrat.
4	Jessór. Masulipatám.
5	Nellúr.
7	Battikótta. Karikál.
8	Álor Gájah. Kådalur. Gantúr.
———	
82·3	Áden. Rajamándri.
———	
83·0	Pallamkótta.
4	Trichinápalli. Vizagapatám.
5	Tinevélli.
6	St. Thomas Mount. Sámarang. Trinkonomalí.
9	Madúra.
———	
84·9	Pondichéri.
———	

PART III.

THE THERMAL STATIONS OF HIGH ASIA.

THE NUMERICAL TABLES OF HIGH ASIA.

Observations and literature.—The groups.—The daily range.—The seasons.—Insolation.—Sanitaria.—The views.

The *materials* for determining the climate of the mountainous regions to the north of India contain already, for various stations of the *Himálaya*, annual periods of some duration. For *Tíbet* few data so detailed could be collected, and the number of stations is altogether small; from analogy, however, observations of shorter duration, such as some travellers' journals offer, proved useful for general considerations. For the plateaux leading on to the *Kuenlúen*, and for its slopes down into Turkistán, I have remained limited to what our passage allowed us to observe when I crossed, accompanied then by my brother Robert, in 1856, and to the materials I found in Adolphe's posthumous papers, from his route up to Káshgar in 1857. As far as I know, the chain of the Kuenlúen has not as yet been crossed by any other European till now (1865),[1] nor have observations of any kind been communicated from these regions.

Táshkend, according to the late news from Central Asia, has been taken by the Russians;[2] but from there, if ever any forward movement should be attempted later, the condition of the country as well as the distribution of the population would give it a southerly direction, passing considerably to the west of the Kuenlúen.

For the Himálaya and Tíbet the work done by previous observers was carefully compared in sketching the outlines of climate. The books in which their notices are contained

[1] Compare the anniversary address of Sir Roderick Murchison to the Roy. Geographical Society, June 1865.

[2] For distances see Route-book, Vol. III., Part I. A telegramm, from 6th of October 1865, viâ Constantinople, reports that the Emír of Bokhára had overtaken and cut down the Russian force left there.

are detailed under the heat of "Literature." Most frequently what these diaries and journals contain are descriptive remarks about climate, together with observations in reference to the snow-line, limits of vegetation and periodical phenomena; many others, as the works of CAMPBELL, CUNNINGHAM, HOOKER, MOORCROFT, STRACHEY, had also to be quoted for the numerical data they contain.

For personal communications we are indebted to Messrs. CAMPBELL, HODGSON, RAMSEY, WITHECOMBE, in the eastern stations; BATTEN, BRERETON, HAY (Kúlu), Sir ANDREW WAUGH, in the western stations; and Lord WILLIAM HAY must be equally named for his energetic exertions, resulting in his finally obtaining for us the latest manuscripts of our brother ADOLPHE from Káshgár.[2]

The groups I preferred making rather smaller than those in India, in consideration of the different types of the climate within these regions, and I arranged the stations throughout geographically, not alphabetically, in order not to accidentally separate too widely stations little differing in elevation. In High Asia climate changes most rapidly in a due northerly direction; within a short distance one can find here types differing more than all along the central line from Bhután up to the Hindukúsh; for on our way to the north we pass from regions of greatest moisture into some of the greatest drought of our globe.[3] The hot moist winds of the Indian plains, where they meet with the first walls of Himálayan chains, have to rise for thousands of feet; they are cooled, the greatest part of their moisture is precipitated already along the first high ranges, and even the *southern* slope of the principal crest of the Himálaya, in consequence of the distance from the plains, is remarkably dry. Here I must especially mention the regions which do not yet belong by their river system to the Tibetan valleys, but where considerable parts are Tibetan already in their climate; I allude to the upper parts of Bhután, Síkkim, Nepál, up to Gărhvál; from here to the west, as in Kashmír, the Tibetan climate more generally coincides too with the line of the principal crest. These surprising modifications excepted, the climate of the different groups

[1] See pp. 17-26 of this volume.

[2] What we got since, was, in 1864: Viâ Amrítsar a draft returned from Yárkand through the Government of Panjáb; and, from Leh, notice about a case found there by the kindness of Capt. AUSTEN, G. T. S.; it contained no scientific materials or instruments, but various things for sake of barter and presents (sold at Leh).

[3] About the resulting effect upon the height and thermal conditions of the snow-lines see the concluding pages of this volume.

can be described much more easily than was the case for India: it differs so much less from what we know already about Europe; this only must be added, that *local* disturbances and alterations are less important than in the Alps; the powerful factors, "Indian heat and storm to the south, and the deserts of Central Asia to the north," make the characteristic features more decided.

The four groups I formed are the following:—

Group 1. The Eastern Himálaya, from Bhután to Nepál; it includes the regions next to the tropics, but considerably cooled by being at the same time unusually moist. Here the direction of the principal crest is from east to west; farther to the west, somewhat before Kămáon, up to Hasóra, it rises nearly diagonally from the south-east to the north-west; the stations of this second part I separated into two groups.

Group 2. The Western Himálaya, south part; includes Kămáon, Gărhvál, Símla.

Group 3. The Western Himálaya, north part; contains the stations from Kúlu up to Kashmír and Márri.

Group 4. The materials for Tíbet and the northern parts of High Asia were limited to observations in the west; we have no data east of 82° degrees of longitude.

Also the *daily range* considerably differs when the eastern and western parts of the Himálaya are compared; it is nearly as small as anywhere in the tropics for Síkkim during the rains; it is more extensive in the drier regions of the Himálaya, to the west or nearer the crest, and it becomes greater still in Tíbet. Where I could collect data sufficiently numerous I added them in the respective groups; very valuable observations for shorter duration are published in HOOKER's Journals, and many observations, for the "term days," the readings being made every hour during one day and one night,[1] I found in the meteorological papers of Darjíling and Kathmándu; in order not to extend too much the following tables, those are left out, as well as our own detailed observations, regularly made with the assistance of our native observers at every station where more than one day's stay had to be made.[2] In mountainous regions, as those of High Asia, the daily variation is subject to many modifications by topographical influence and seasons.

In the free air,[3] also in very high mountain regions, if the influence of

[1] From 6^h A.M. on the 21st to 6^h A.M. on the 22nd of the respective month.

[2] Compare the details about the books of manuscripts kept during the travels, p. 6 of this volume.

[3] For considerations on the temperature in the free air see p. 141 of this volume.

rocks locally increasing temperature by the heat they radiate after having been exposed to the sun, can be properly excluded, the daily variation becomes very small.

The seasons I have arranged here, as throughout,[1] in conformity with our European seasons; in the north-western parts of the Himálaya and in Tíbet they actually are the same as in the European Alps, the beginning of spring—or rather summer at once—as well as the duration, chiefly depending upon height. More to the east and south, most distinctly so in Síkkim, the early setting-in of the rains and their intensity make the seasons sensibly differ from those of the neighbouring Indian plains, by the hot season being eliminated nearly completely; the cool season is soon followed by the rains, and these are but little interrupted even in the first part of autumn.

Insolation. The great difference between various parts of High Asia in reference to rain and moisture coincides with an analogous alteration in the number of days of sunshine; but also when no clouds, no fog or haze interfered, I observed additional modification depending upon the relative moisture, just as already detailed for the tropical regions: under circumstances otherwise equal a great amount of moisture increases the effect of solar action, by limiting the contemporaneous loss by radiation.

The number of days of sunshine is greatest in Tíbet; indeed, in many a year not one day passes when the sun does not come forth at all, and months may be observed without any cloud of appreciable size. For the outer ranges of the eastern Himálaya we shall see in the Darjíling table, that on 200 days out of the year (in an average of three years) no observations of insolation at about the maximum of the day could be made, and occasionally weeks in succession passed during the height of the rains without any sunshine at all.

The effect of solar heat, as regards accumulation of heat, such as in the soil exposed, n ripening the crops, in melting snow, is in favour of the regions with frequent sunshine; and most distinctly is it observed to be so where the frequency of clouds begins already to be reduced without the drought having already reached its full height. The isolated readings of the thermometer exposed to the sun's rays, however, show the absolute

[1] For details see above, Chapt. VI.: "The Yearly Period of Temperature," p. 113.

extremes to be met with in the eastern regions, where moisture, and also clouds and rain, predominate.

For the present some examples of the insolation observed with a thermometer with black bulb, exposed to the sun's rays, may be sufficient to illustrate it; the detailed experiments shall be given, together with those made in the tropics, in the optical part of the meteorological researches.[1]

For Western Tíbet, for a height above 11,500 feet, I quote the readings at Leh, selecting the finest days near the middle of July and September.

LEH: Latitude North	34° 8′	
Longitude East Green.	77° 15′	
Height	11,532 ft.	
	July	Sept.
Height of the Sun, at Noon	77½°	59°
Thermometer in the Sun's rays at 1^h P.M.	92°	88°
Temperature of the Air:		
Mean of the day	66°	56°
Maximum of the day	79°	68°
Relative moisture, at 1^h P.M.	47°	30°

When in the same heights in Síkkim in 1855 I had no opportunity of making a *complete series* of such observations, the interruption of clouds and rains being of too short duration; but even such breaks already allowed one to judge of the effect of limited loss by radiation; it best became apparent by the pyrheliometer when turned away from the sun. The more welcome were to me the observations I found in HOOKER'S "Himalayan Journals." They were made in the cool season, in heights very little differing from those in Ladák. Though he gives but the readings of thermometers with black bulb, without other details than the elevation, they may be combined with mine in Leh by the considerations herewith added. He obtained: in *December* (Lat. about 28, Solar altitude at noon about 40°), at 10,000 feet, at 9^h A.M.: in the sun 132° Fahr., in the shade (temperature of the air): 38° Fahr.; on other days, at 11,000 feet, at 11^h: in the sun 122° Fahr., in the shade 40° Fahr. The differences therefore amounted here to 94 and 82° Fahr., and this fully allows one to expect a difference of 75 to 60° Fahr. for a thermometer with unblackened bulb. Whilst I made my experiments at Leh, the

[1] See Vol. V. of the "Results."

[2] HOOKER, "Himalayan Journals," Vol. 2, p. 410.

the solar altitude, and not less the contemporaneous temperature of the air, would have tended to increase the difference; nevertheless it there only reached 20 degrees. Humidity is not added in HOOKER's experiments, but it can well be expected that it considerably exceeded at all events that at Leh, unless a quite exceptional decrease towards the interior must be admitted, if we consider that at Darjíling the mean of the relative moisture is 81° for December (for the year it is 84°).

In conclusion, the following table presents for Darjíling the annual variation; it is the *mean* of the three years 1857-59.[1]

DARJÍLING: Latitude North. 27° 3′ Longitude East Green. 88° 15′ Height. 7,168 feet.

Months.	Mean Insolation.		Mean Temp. of the air.	
	Temperature.	Number of days.	Daily mean.	Mean maxima.
January	91	20 }	43·9	50
February	92	17 } ⅔	44·8	51
March	101·4	22 }	51·0	57
April	101	15 } ½	53·9	60
May	102	14 }	58·2	63
June	103	8 } ¼	60·8	64½
July	104	6 }	61·5	64½
August	99	10 } ⅓	61·5	65
September	101·9	12 }	60·2	64½
October	96·1	17 } ½	56·6	61
November	95·8	16 }	50·5	57
December	89·9	10⅓	44·1	51

For 1855,[2] the year of my visit to Síkkim, the *absolute extremes* of insolation I found in the books of registers were:

In January, 116° Fahr.; the greatest transparency of the atmosphere coinciding then with the minimum of the earth's distance from the sun. Altitude of the sun at noon: 41½°;

[1] For details of the observers, &c., see p. 480, and Parliamentary Reports on the Sanitary State of India, Vol. II., p. 141.

[2] As to the *means*, I preferred limiting myself to the period following my visit; the readings in 1855 appeared not completely to exclude days when occasionally some haze interfered.

In June, 126° Fahr. a short time before the maximum of northern declination of the sun. Altitude of the sun at noon $86^1/_4$°;

In July, 129·9° Fahr.; maximum of the thermometer in shade 66·8. Altitude of the sun at noon $84^1/_2$°.

As *sanitaria* the Himalayan stations are excellent retiring places from tropical heat. In reference to temperature the heat is moderated, and the air is refreshing without being too cool: but they are not equally favoured by the modification of moisture, an element important enough. The rain increases up to a certain height in quantity and duration, and the resident then finds himself confined to the station, if not to his house: a frequent steamy fog, lasting for days, is then felt severely by invalids. Even in the dry and cool season the relative moisture is still great, when compared to stations of the same temperature and distance from the sea-shore in Europe, but not inconvenient. Autumn, charming already in all steps of the Himalayan ranges selected for sanitaria, is soon followed by a bracing cool season; the latter cannot be enjoyed enough, as it is also the season most favourable to activity and service in the tropics.

Amongst the diseases of local type, dyspepsia is not unfrequent in the moist regions to the east, endemic diarrhœa in the western parts; in rheumatic cases the stay in elevated stations frequently increases the complaint; natives are, from want of precaution and protection, the most exposed to rheumatic attacks. Children, as has been observed at Nainitál, often suffer from bronchitis, if not sufficiently protected against exposure in the rainy season. Fevers of a remittent and intermittent type, and the debility following such complaints, are those cases for which the Himálayan sanitaria are the most beneficial. Unhappily the climate of India and the distance from Europe send to these stations many a resident whose severe organic disease of liver or intestines could not hope for much benefit even from a stay in any watering-place of Europe. Such cases must not interfere with our appreciation of the climate.

But as soon as we come to compare the climate of the outer ranges—their eastern parts especially—with those farther to the west and north and more distant from the borders, we soon observe the advantages of the latter.

Kashmír is in this regard the country to which the preference must be given;

and the environs of Srinâger, above all, combine a climate most congenial to Europeans in every season, with the charms of a rich and beautiful country, inhabited by an intelligent population.[1]

As to the political difficulties which might interfere with making Srinâger a sanitarium, I consider this a question which it is not my task to treat of here; as to the physical conditions, none can be equally recommended. This circumstance, too, must here be pointed out, that the progress of the railways all along the foot of the Himâlaya is so very rapid, that for a sanitarium it becomes infinitely less important to consider what is the distance from an Indian station, than to keep in mind what is the condition of the place to be chosen.

The *views*, as far as illustrating meteorological phenomena, are quoted here too, as I did for the tropics,[2] but in connection with the different meteorological groups; provincial types being here so intimately connected with topography and climate. The special desire soon to *complete* my views of the salt-lakes, on account of the novelty of many a detail they displayed and their connection with so various physical and geological questions, had not allowed till now of my giving some of the larger panoramas from the eastern regions.

[1] One view, *Panorama of the Lake and Gardens near Srinâger,* I have already given in Part III. of the Atlas, Plate 18.

[2] See p. 116 of this volume.

GROUP I: BHUTÁN, SÍKKIM, NEPÁL, IN THE EASTERN HIMÁLAYA.

Nărigún.—Pankabári; Darjíling; Tónglo; Falút.—Kathmándu.

The Eastern Himálaya, with elevations unrivalled in height and steepness of ascent, is bordered on the south by plains only 200 to 350 feet high; these plains reach down to the bay of Bengál without any secondary range modifying the climatological influence of the temperature and moisture of the tropics.

Síkkim, with which we shall begin, shows best the full power of the ascending currents from the plains and the sea. They rush high up its slopes where directly exposed, or follow the course of its valleys: the mildest temperature, the greatest amount of moisture, mist, and fog, and a quantity of rain only exceeded[1] in a few subtropical regions (a little less distant still from the sea), are the consequences.

The direct action of the sun is much reduced in frequency by the cloudy sky, but the moist atmosphere makes its effect the more powerful upon animal and vegetable life, and a vegetation as luxuriant as it is characteristic in its forms for these

[1] I allude to Cherrapúnji, where the amount of rain is 5 times greater still (see p. 180), but where, nevertheless the moisture from September to May is considerably less. In the outer ranges of Síkkim the quantity of rain varies between 100 and 130 inches in different years.

regions, including the wildest forests, full of rhododendrons, tree-ferns, and magnolias, is the consequence.

The moisture, although by far the greatest part is attributable to the topographical conditions, is yet increased by the very vegetation it produces; in passing though the forests a part of the steam is kept back (which otherwise would pass higher up inland) and evaporates during those hours when the air happens not to be saturated already. The clearing of the forests round the settlements, as is now in progress to make room for the cultivation of tea,[1] is already felt by the influence it exercises in modifying the accumulation of mist on the slopes. Man in his habitations avoids the very low valleys, unhealthy by malaria; even the native settlements are generally seen on the spurs, not descending below 2,000 or 3,000 feet.

The tarái bordering the foot, about 380 feet high where it touches Bengál, is bad enough, but from being much more narrow here than where it borders Nepál, it is more easily passed, and less dangerous. In reference to temperature it differs little from that of the adjoining Bengál; great heat is frequent before the rains, in the cool season the temperature is rather cooler than in Bengál, on account of the influence of descending currents very limited in circulation. The European stations do not begin below 6000; local exceptions may be the consequence of the rapid spread of plantations during these last years.

The early mornings are here, as in India, the most precious hours; though not on account of their being cool only, but especially since for a great part of the year this is the only moment which allows, by the transparency of the atmosphere, fully to enjoy the grand scenery of the country. A few hours after sunrise, too often sooner still, fogs spring up, lasting with little modification for the rest of the day.

In heights above 10,000, as I had occasion to observe even in the rainy season along the Singhalíla ridge, days of sunshine, for some hours at least, are much more numerous. In winter, as Hodgson and Campbell told me, the aspect of the snowy mountains often becomes interfered with by a dry reddish haze apparently connected with solid particles suspended in the atmosphere—carried up by the ascending current from the plains of Bengál, as it shows itself positively interfered with by the accumulation of moisture.

[1] For recent statistical and botanical details especially about the important cultivation of tea, see Dr. Forbes Watson's reports in his Catalogue of the Indian Department of the Exhibition of 1862, p. 66.

Nocturnal radiation is considerably reduced by the steamy character of the atmosphere; but isolated minima of *the air* (without the thermometer being exposed to radiation against the open sky) frequently fall to the freezing point at heights of 7,000 to 7,500 feet.

On the rhododendrons a curious effect of curling of the leaves is the consequence of unusual cold; when we approach the upper limit of rhododendrons, in heights above 10,500 feet, such curled leaves become gradually more frequent, but it is also observed, probably in consequence of an accumulation of cold air along the ground, that often the larger trees with the foliage beginning at some height appear to be unaffected.

In two localities on the Singhalíla ridge, one at a height of 10,628 feet,[1] I have seen "dead forests" of hundreds of trees of the species of *Abies Webbiana*, showing but ruins of the stem, destitute of bark, even of the greater part of their branches.[2] They had evidently been killed by the frosts of an unusually cool season without becoming replaced till then. Occasionally we see such trees, though isolated groups only, in the Alps; but there our *Pinus Cembra* appears to have to stand a minimum of — 24° Fahr.,[3] whilst here some + 10° to 5° Fahr. may have done the same.

Many analogous observations might be added as being not unconnected with climate, though digressing rather too far from the special objects of this volume. Of my views only two have been produced till now: the aspect of Gaurisánkar, 29,002 ft., and that of Kănchinjínga, 28,156 feet. In the first of the plates we see as to the sky the dark tint of the tropics, increased by the elevation, at midday in summer, but somewhat modified by a rainy haze, with cirrostratus appearing. The view of Kănchinjínga, from the Singhalíla ridge, is taken at a moment peculiar to the Síkkim climate, at a morning aspect. The high towering peak already reflects the glaring light of the sun, whilst the valleys are filled with dense fogs rapidly rising,

[1] "Results," Vol. II., p. 390.

[2] Later a view of it shall be given in my plates from the drawings, Or. N., 237 and 238. Also my Bhútian companions considered such spots as having been killed by frost. As the Tibetan name of "Dead forest," I was told *nagdul* (spelt nags'brul) = "the forest fallen off."

[3] This was the minimum observed at Vent, in the valley of the Oetz; in Tyrol ("Phys. Geogr. of the Alps," Vol. I., p. 371). Cembra-trees were found above it near Rofen, at a height of 7080 feet (ibid., p. 482).

the upper margin of which still gives a strong reddish tint to the lower parts of the snow.

As to the larger Panoramas which are soon to follow, it may be remarked here that also in the rainy season, if the fogs completely dissolve, the transparency of the atmosphere may exceptionally become very perfect; and this remains the less unnoticed here on account of the grandness of the objects we see spread before us[1]—summits of above 28,000 feet and the bottom of valleys full of dense vegetation, with an elevation of 1,500 to 2,000 feet only; the whole of the panoramic aspect being overtowered, as I saw it from Falút, by an interrupted snowy range occupying more than the half of the horizon.

In Bhután the climate differs considerably, not being so moist, and by its variation, in consequence, being greater in the daily as well as in the annual range; the hills from the Garrows up to the hazes have intercepted and precipitated already the greater part of the atmospheric moisture carried over by the monsun from the tropical seas, before it reaches the Himálayan mountains. Also within Bhután itself the moisture very rapidly decreases on approaching the Himálayan crest. Artificial watering of the mountain slopes by canalisation, such as we meet with very frequently in Tíbet, begins here already at about half the breadth of the Indian slope of the Himálaya.

The tarái, participating in the climate detailed for Assám, is dangerous chiefly in the rainy season and soon after the rain; in the cool season 1855 to 1856 I encamped there repeatedly on my way up to Narigún, and the decrease of malaria is considered to continue till the first rains set in.

For descriptive accounts the works of Turner and Pemberton have been quoted already in the synopsis of Literature;[2] a view from the environs of Narigún will be given later in the Atlas.

Pemberton's "Report on Bootan," pp. 197-207, contains for some of the stations meteorological observations. Regular stations may be expected at a time not too distant from the successful termination of the present war.

[1] See pp. 165 to 168.

[2] In Kishen Kant Bose's "Account of Bhután," translated by Scott, Asiat. Res., Vol. XV., all I could find in reference to climate or vegetation, are some isolated remarks about crops, p. 145, snow p. 141, rain p. 149.

Nepál differs essentially in topography and climate from the two mountainous regions hitherto described. Its tarái is broader and therefore more dangerous, though the quantity of rain has considerably decreased already; its hot season is felt more distinctly as such, but the remaining months are the more agreeable.

Topographically the difference from Síkkim, even from most of the other parts of the Himálaya on either side of Nepál, is greater still; here we meet large lake basins, drained now, it is true, by the depth of the erosion of their outlets, but marked as lake-basins most distinctly by the banks of deposits as well as by the uniformity in level, over surfaces sometimes very large. Kathmándu, the capital, is situated in one of these lacustrine basins, drained into the Găndák; also in the river-system of the Kási, immediately to the east, such level deposits of fresh water lakes are the predominant feature of its central part.[1]

The countries along the eastern Himálaya contain in the northern parts also some of the regions situated beyond those ridges which present the steepest ascent and the highest peaks, but which nevertheless are followed still by high grounds comparatively flat before the crest forming the watershed appears. The climate of these provinces completely differs[2] from that of the Himálaya: it is of the Tibetan type, as detailed above.[3]

[1] As the questions which recently have connected lakes, glaciers and snow-lines will give me occasion to describe some more of the traces of lakes, also in Tíbet, I only add here that the panoramic view of the Nepalese snowy range (Or., No. 360), which is soon to follow in the Atlas, contains in its central aspect also the lacustrine flats round Kathmándu.

[2] In Europe, too, we have similar cases, but they are seldom so striking. Gibraltar deserves perhaps best to be quoted, as its climate materially differs from that of Spain and is quite that of the African coast.

[3] See p. 466 of this volume.

Năригún, in Eastern Bhután.

Latitude North.	Longitude East Green.	Height.
28° 53′·8	92° 6′·0⚐	3,642 feet.

1856. Though not including the whole of the month of January, the result obtained during my visit from Assám can be considered the mean of January, since also the corresponding observations at Goháttí differ but inappreciably from the result obtained as the mean of three years.
Schlagintweit, "Beob.-Mscr.," Vol. 14.

The means I added in round numbers, for the other months are deduced from observations I had occasion to make in 1855 and to have continued in 1856 by a part of my establishment left behind; they were made in the surrounding hills, but their reduction to the height of Năriġún was the more easy as generally the difference of height was but very small.

The travels of Turner and Griffith do not contain sufficient data for deducing monthly means.

1855-6. Mean of the months.					
January	46·6	May	68	September	71
February	52	June	73	October	67
March	60	July	74	November	58
April	62	August	74	December	52

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
50·2	63·3	73·7	65·3	63·1

BHUTÁN, Western provinces. Approximate means.

They are calculated from PEMBERTON's tables; the hours of observation being 10^h A.M. (and occasionally 9 or 9^h 30^m) I deduced 3° Fahr. for reduction to the mean of the day. (Arranged by height.)

DEVANGÍRI, on the outer ranges of the Himálaya, on the left bank of the Múru.

Latitude North.	Longitude East Green.	Height.
26° 51′	91° 30′	2,150 feet.

1839, January 4 to 23: 55° Fahr.

TASSGÓNG, fort in the Monás valley.

Latitude North.	Longitude East Green.	Height.
27° 20′	91° 38′	3,182 feet.

1839, February 1 to 5: 53½° Fahr.

PUNÁKHA, fort on the junction of the Ma-ju and Pa-ju.

Latitude North.	Longitude East Green.	Height.
27° 35′	89° 34′	3,739 feet.

1839, April 2 to May 4: 66° Fahr.

SÁSI, near the junction of the Thénuri and Jhíri.

Latitude North.	Longitude East Green.	Height.
27° 8′	91° 29′	4,325 feet.

1839, January 27 to 31: 47° Fahr.

LENGLÚNG CASTLE, on the Kúri.

Latitude North.	Longitude East Green.	Height.
27° 39′	91° 12′	4,523 feet.

1839, February 19 to 24: 51° Fahr.

TASSÁNGSI CASTLE, Kúllong valley.

Latitude North.	Longitude East Green.	Height.
27° 34′	91° 33′	5,387 feet.

1839, February 11 to 14: 43° Fahr.

TÓNGSO FORT, on the right bank of the Malisúm.

Latitude North.	Longitude East Green.	Height.
27° 30′	90° 19′	6,527 feet.

1839, March 6 to 18: 50° Fahr.

PĂNKABÁRI, in Síkkim.

Latitude North.	Longitude East Green.	Height.
26° 49′	88° 14′	1,790 feet.

1855, April and August.

This station, being the first halting-place above the Síkkim tarái, connects by its position the plains with the higher regions.

The observations were made by my draftsman Ábdul, when I came up in April; in August my assistant, Lt. ADAMS, had taken charge of the readings.

SCHLAGINTWEIT. "Beob.-Mscr.," Vol. 19.

1855							
Month.	SR.	4^h P.M.	Mean.	Month.	SR.	4^h P.M.	Mean.
April	64·6	70·2	67·4	August	72·8	87·2	80·0

DARJÍLING, in Síkkim.

A. Observatory Hill:

Latitude North.	Longitude East Green.	Height.
27° 3′·0	88° 15′·3 ♁	7,168 feet.

1850-3, 1855, and 1857-9. WITHECOMBE. The instruments were put up very carefully, with the special assistance of Dr. CAMPBELL, the superintendent. From 1855 the hours of observation were 6^h and 9^h A.M., 3^h and 9^h P.M.; the means of the preceding years can be considered as the mean of SR. and the maximum of the afternoon. As the daily variation of temperature is but very small for the whole year, the combination of these values showed itself sufficiently accurate when compared with the hourly observations I had occasion to make there in 1855.

1857-9. WITHECOMBE; SIMPSON; COLLINS. The mean for 1857 to 59 appeared first in the Parl. Sanitary Report, Vol. II., p. 141, the hours of observation are not detailed there; but Dr. WITHECOMBE personally informed me in London, that they had remained the same with Dr. SIMPSON, his successor.[1]

[1] The values Dr. GLAISHER gives, Parl. Rep., Vol. I., p. 834, are the mean of the temperature of the barometer, inside the house. (Also seen when compared to the table, Vol. II., p. 141.) The values communicated by Sir RANALD MARTIN, ibid. Vol. I., p. 503, to which the year is not added, may be considered as a part of Dr. WITHECOMBE's observations.

B. To the means from Observatory Hill two other series[1] of observations are added from Dr. HOOKER's Journals: Jillapahár and CHAPMAN's Bangalow. *Jillapahár,* 7,430 feet. The mean I calculated by the combination of the homonymous hours 8^h A.M. and 8^h P.M., 9^h A.M. and 9^h P.M.; the approximate mean of the year for Jillapahár could be estimated 1°·5 below that of the Observatory Hill, the monthly differences being from July to October 1°·6, 0°·6, 2°·1, 1°·6 Fahr.

Dr. CHAPMAN's Bangalow, about 7000 feet.[2] No detail is known about hours of observation and their combination.

Daily variation.

Hourly observations in Síkkim were first made for some months by Dr. HOOKER;[3] his instruments were put up at Mr. HODGSON's bangalow. The results as to temperature are contained in the following table.

Hourly observations at Jillapahár, 7,430 feet.

1848	July.		August.		September.		October.	
	Temp. Air.	Number of observations.	Temp. Air.	Number of observations.	Temp. Air.	Number of observations.	Temp. Air.	Number of observations.
1^h A.M.	59·6	7	59·8	15	....	..	....	..
6 to 6½	....	..	....	..	....	..	54·4	11
7	....	..	....	..	....	..	54·3	19
8	62·1	23	62·1	26	59·2	28	55·2	20
9	62·6	27	63·1	28	60·1	29	56·3	20
10	63·5	22	64·3	28	60·8	28	57·1	19
11	64·1	20	64·7	24	61·6	24	57·6	13
Noon	65·0	26	64·7	23	62·4	23	57·9	15
1^h P.M.	64·1	12	65·3	21	62·7	23	58·0	13
2	64·4	11	65·0	21	62·8	23	57·7	13
3	64·8	25	64·8	21	62·3	23	57·9	14
4	64·1	23	63·9	19	61·8	23	57·9	16
5	64·7	13	63·2	19	60·3	19	56·6	13
6	63·7	10	62·3	19	59·4	19	55·9	6
7	62·7	6	61·6	19	58·7	20	55·4	7
8	61·0	6	61·1	19	58·2	21	53·7	3
9	60·7	22	60·7	19	57·8	22	55·1	7
10	60·5	6	60·3	19	57·4	24	54·6	14
11	60·2	6	60·1	19	57·0	24	54·5	18
Mdn.	59·8	19	60·0	19	56·7	23	54·1	14

[1] The numerous isolated observations carefully made by Dr. HOOKER in the environs of Darjíling and at very different heights in the interior of Síkkim, Himálayan Journ., pp. 424-40, are compared there with the *contemporaneous* values at Calcutta, especially for defining the laws of the distribution of moisture; I shall have occasion later to quote them in reference to these results.

[2] HOOKER, Himálayan Journ., Vol. II., p. 419. CHAPMAN's Bangalow is said there to be "a little higher than MULLER's" (6,956 feet) and very near it.

[3] Himálayan Journal, Vol. II., pp. 420-21.

Only during the last month do the observations include the time of the minimum of the day, thus representing the complete amplitude of the daily range; it appears, also, from the difference between the successive hours, to be less still along the slope on which this bangalow stands than in the exposed situation of the Observatory Hill. As to the variation within day-time, the haziness and the fogs increasing in the afternoon produce another deviation from ordinary daily variation: the mean maximum approaches noon or $12^h\ 30^m$ P.M.; whilst in India we saw it take place at $2^h\ 30^m$, even as late as nearly 4^h P.M. in the hot season.[1]

The minimum of the mornings I found followed at Darjíling, as I had observed it in the tropics along the coasts and in the open sea, by a second depression, not quite so regular; but the difference, when it showed itself, became greater, frequently amounting to 1° or $1^1/_2$° Fahr.; in most cases it can be seen coinciding with the clearing-up[2] of fog, when a certain quantity of heat becomes latent.

The variation seems not to increase much in the lower parts of the valleys. At the very bottom of the valleys, where low, even natives avoid passing a night, in consequence of the dangerous accumulation of malarious moisture; the lowest 24 hours' series, however, I have, is that from the coal and copper mines below Mahaldirám.

[1] See pp. 54 to 98 of this volume.

[2] This we find described as observed distinctly still in the cool season, in Hooker, Himálayan Journals, II., p. 411.

The values I obtained for the temperature of the air are:

MAHALDIRÁM COPPER MINES.

Dāk bángalo: Latitude North. 26° 53′ Longitude East Green. 88° 17′·1 Height of the bángalo: 6,574 feet.

Height of the mine: 2,780 feet.

1855, June 30th to July 2nd.							
A. M.				P. M.			
Mdn.	73·2	6	72·5	Noon.	76·5	6	74·5
1	73·0	7	74·3	1	77·9	7	74·3
2	72·9	8	75·9	2	75·4	8	73·9
3	72·9	9	76·0	3	75·4	9	73·8
4	72·8	10	76·1	4	75·2	10	73·6
5	72·7	11	76·2	5	75·2	11	73·4

July 1st a dissolving of the fog began at $8^h\ 15^m$, and at $8^h\ 35^m$ a second depression not lower, however, than 74·9 was observed; it soon disappeared with the increase of the ascending breeze; in the afternoon from $1^h\ 40^m$ P.M. the descending northerly breeze set in, followed by a little rain at $3^h\ 10^m$ P.M.

Mean and absolute extremes. The values of the first table are those obtained at the Observatory Hill[1] from April 1855 to May 1856, with two registering instruments I left there.[2]

CHAPMAN's tables, in HOOKER's Journals, p. 49, in 1837, show greater variations throughout; the absolute extremes he obtained are contained in the second table.

[1] Dr. CAMPBELL took the trouble to send me every month the results obtained at the Observatory..

[2] How different from the lower parts of the Alps, where for Bern we can quote 97°·2′ Fahr. as the absolute maximum, and — 22° Fahr. (54 below the freezing point!) as the absolute minimum. SCHLAGINTWEIT, "Phys. Geogr. of the Alps," Vol. I., p. 371.

Darjíling Observatory Hill, 7,161 feet; mean and absolute Extremes. 1855-6.

Mean Extremes.			Absolute Extremes.	
Months.	Min.	Max.	Min.	Max.
January	33	46	28	58
February	37	48	32	54
March	43	50	39	57
April	49	58	45	61
May	56	60	50	69
June	58	65	55	68 1/2
July	58	67	56	70
August	58	66	56	70
September	56	65	53	69 1/2
October	52	60	46	65
November	43	52	38	57
December	38	48	31	53

Darjíling, Chapman's Bangalow, ab. 7,000 feet; absolute Extremes, 1837.

Months.	Min.	Max.	Months.	Min.	Max.
January	29·0	56·0	July	56·0	69·5
February	25·5	57·0	August	54·5	70·0
March	37·0	66·5	September	51·5	70·0
April	38·0	68·5	October	43·5	68·0
May	38·0	69·0	November	38·0	63·0
June	51·5	71·0	December	32·5	56·0

DARJÍLING, *Monthly Means.*

A. Observatory Hill. 7,168 feet.

Months.	1850	1851	1852	1853	1855	1857-9	General[1] mean.
	Mean of the months.						
January	42·4	....	42·9	37·6	39·4	43·9	42·0
February	41·3	....	47·1	46·4	41·9	44·8	44·4
March.	48·4	....	46·7	52·6	....	51·0	50·1
April	56·7	....	53·9	57·3	....	53·9	54·8
May	58·9	....	57·9	60·9	....	58·2	58·7
June	62·8	64·4	62·1	....	60·9	60·8	61·8
July	63·5	64·4	63·1	....	62·2	61·5	62·9
August	63·2	64·8	63·6	....	62·0	61·5	62·6
September	62·3	63·0	61·8	....	60·4	60·2	61·1
October	61·8	54·3	56·0	....	....	56·6	57·0
November	54·5	....	58·0	....	....	50·5	52·8
December	45·9	....	42·7	....	....	44·1	44·2
Mean	55·2	....	54·7	....	....	53·8	54·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
43·5	54·5	62·4	57·0	54·4

[1] In taking the general mean the last column was introduced, with its value of three years.

B. JILLAPAHÁR, HODGSON'S Bangalow, 7,430 feet; Means, 1848.

July: 61·3; Aug. 62·0; Sept. 59·0; Oct. 55·4.
(Year: 52·9.)

C. CHAPMAN'S Bangalow, ab. 7,000 feet; Means, 1837.

January	40·0	May	57·6	September	59·9
February	42·1	June	61·2	October	58·0
March	50·7	July	61·4	November	50·0
April	55·9	August	61·7	December	43·0

Year: 53·5.

TÓNGLO PEAK, in Síkkim.

Latitude North.	Longitude East Green.	Height.
27° 1′·8	88° 3′·9 ♁	10,080 feet.

1855, May 10 to 15, hourly readings during my stay for the magnetic observations.
SCHLAGINTWEIT, "Beob.-Mscr.," Vol. 19.

They may be considered at the same time to differ but little from the true mean of May.
This peak is the most southern prominent point of the Singhalíla ridge.

Approximate Mean of the May.

A.M.				P.M.			
Mdn.	44·5	6^h	46·2	Noon	55·0	6^h	47·1
1^h	44·4	7	48·2	1^h	53·8	7	46·0
2	44·3	8	49·6	2	53·6	8	46·1
3	44·2	9	51·1	3	50·4	9	45·4
4	44·2	10	51·4	4	50·9	10	45·0
5	44·4	11	53·2	5	48·9	11	45·1

Mean: 48·0.

FĂLÚT, or SINGHALÍLA PEAK, in Síkkim.

Latitude North.	Longitude East Green.	Height.
27° 13′·7	87° 59′·8♁	12,042 feet.

1855, May 21 to 31, and June 1 to 11; hourly readings during my stay for the magnetic observations.

SCHLAGINTWEIT, "Beob.-Mscr.," Vol. 19.

Approximate Mean of May and June.

A. M.				P. M.			
Mdn.	43·5	6h	44·9	Noon	52·2	6h	47·3
1h	43·1	7	46·2	1h	52·5	7	46·4
2	42·8	8	48·2	2	51·1	8	45·7
3	42·6	9	50·2	3	50·0	9	45·1
4	42·6	10	50·9	4	49·1	10	44·6
5	43·1	11	51·8	5	48·2	11	44·2

Mean: 46·9.

KATHMÁNDU, the capital of Nepál.

Latitude North.	Longitude East Green.	Height.
27° 42′·1	85° 12′·2	4,354 feet.

1835-9. H B. HODGSON and A. CAMPBELL. The readings were not made at the same hours of the day throughout, but they included for every day one hour near sunrise and an afternoon observation between 3 and 4. Besides, Dr. CAMPBELL had repeatedly made 24 hours' observations which materially facilitated my deducing the true means. Some of these hourly observations were periodically published in the India Review. For the communication of a complete copy of the original books of the observations of this period I am indebted to Mr. HODGSON.

1851-7. This series was registered by the Residency surgeons and kindly communicated to me in 1857, when in Nepál, by Col. RAMSAY. The observations in 1856 and 57 were made by Dr. BROWN, who also most readily assisted me in obtaining more detailed corresponding observations during my own stay in Nepál. SCHLAGINTWEIT, "Beob.-Mscr.," Vol. 19.

Months.	1835	1836	1837	1839	1850	1851	1852	1853	1854	1855	1856	General mean.[1]
Jan.	....	47·5	42·8	50·0	....	46·3	41·2	40·0	(45·4)	44·4	47·8	45·4
Febr.	....	43·0	45·0	53·4	....	(50·0)	49·1	52·8	50·0	52·0	50·9	50·3
March	....	53·2	54·8	59·7	....	56·9	51·9	58·2	57·1	56·6	60·7	56·6
April	62·3	60·6	60·7	64·2	....	60·8	57·1	62·1	61·5	61·9	65·1	61·6
May	69·1	68·6	65·1	67·8	....	67·8	63·9	67·3	68·3	69·6	68·2	67·5
June	69·4	72·2	74·4	71·3	....	71·3	68·7	73·6	73·0	73·0	73·7	72·1
July	71·5	71·2	69·4	70·7	....	71·7	72·7	74·3	74·1	73·4	73·7	73·1
Aug.	71·5	74·8	72·9	74·9	73·3	72·2	74·8	71·9	73·6	71·9	72·6	73·1
Sept.	69·3	70·9	70·6	72·3	70·8	70·6	71·0	70·3	70·9	70·2	70·6	70·7
Oct.	61·2	60·8	(64·7)	66·0	65·3	63·9	65·3	63·3	65·6	64·2	71·0	64·7
Nov.	49·8	(55·6)	(55·6)	59·5	54·8	52·2	56·4	55·8	59·2	55·9	56·7	55·6
Dec.	43·6	(49·5)	(54·8)	(49 5)	49·9	45·7	49·3	49·9	49·9	47·2	50·4	49·5
Mean	....	60·7	60·9	63·5	....	60·8	60·1	61·5	62·4	61·7	63·5	61·7

Isolated months (included in the means). 1857: Jan. 48·9; Febr. 53·6. 1838: Dec. 54·2.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
48·4	61·9	72·8	63·7	61·7

[1] The numbers in Parl. San. Rep., Vol. I., p. 834, could not be introduced into these means, as they are not detailed in reference to periods or hours of observations.

GROUP II: KĂMÁON,

GARHVÁL, SÍMLA, IN THE HIMÁLAYA.

Lohughắt; Havalbágh; Almóra; Nainitál; Mílum.—Déra; Landáur; Măssúri; Jhósimath; Bádrinath; Níti.—Sabáthu; Dăgshái; Kotghắr; Kassáuli; Símla.

From Kămáon to Símla the predominant type of the climate, in the outer ranges, (from 2,000 to 7,000 feet) is the following:

The *cool season*, down to 3,000 feet, is most bracing, even cold in the higher stations, where snow occasionally falls, although on the whole in but small quantity,[1] since this period of the year is the dry season for the surrounding countries.

In *spring*, the hot season of the plains, the temperature rises rapidly; but to no inconvenient degree even in the lower grounds.

The *chóta parsắt*, or early rains, preceding the rainy season for a month or six weeks, are rare in the central regions, but in the ranges next to the plains we still observe them; nevertheless the tarái is nowhere dangerous to pass, either at this or at any other period of the year.

In the interior, however, in the higher parts least distant from the crest, the distribution of the rain is quite a different one again; the principal precipitation takes place

[1] The winter may be at times very severe and the quantity of snow great enough. In February 1836 snow lay some feet deep at Símla, and, where accumulated by the wind in protected ravines, local *bas-névés*, or snow-beds, were found still as late as the end of May. Also in the South of Europe heavy falls of snow, irregularly as they are distributed, are not quite unfrequent and may become very great. Recently only, Dec. 25 to 27, 1864, 50 Centimeters of snow ($1\frac{1}{2}$ feet) covered the fields in the south of France round Cette, Narbonne, and Carcassone.

in March, April and beginning of May, and this very rain it is which has not less a share in the rapid dissolving of the snow from the flanks of high valleys than the gradual increase of the temperature.

The *rainy season* for the outer ranges is about the same as for the plains; it begins rather earlier than in Hindostán, and the rain increases here, as detailed for the Groups preceding, by the moisture being carried up along the flanks of the mountains; but the amount of increase is no longer so great, partly in consequence of the distance from the sea being considerable on *both* sides, partly by the interception of moisture in the mountains of Bahár and Bǎndelkhånd.

In Dĕra and in Măssúri the rain continues often for a long time—not extremely heavy, but without any interruption at all. I found noted that at Măssúri 81 days of such rain had been observed.

In Kănâur, and in all the provinces in the interior, June, July and August are by far the warmest months, little interrupted by rains, except in the form of storms followed occasionally by a few cool rainy days.

In *autumn* the rains are over, also for the outer stations; even the greatest part of August is already quite sunny, though still very moist. A dry refreshing period rapidly follows; occasionally, as in 1855, even October may have days unusually warm, with a kind of hot wind.

Local modifications are frequent, as anywhere in a mountain system where deep valleys and great heights are so near each other; the exposed situation of the slopes, and the accumulation of cold air in deep valleys where circulation is limited by curvatures, are the principal causes; forests are here beautiful still, but neither so extensive nor so dense as I had found them in the eastern parts.

As an instance of the exceptional differences we had occasion to observe, I may quote that at Jhósimath, at 4,724 feet, Robert obtained, end of July, a daily mean of $69°\cdot8'$ Fahr. whilst nearly 6 weeks earlier the mean temperature of Mílum, at 11,262 feet, had been $63°\cdot5'$.

The *daily range*, also in these more western parts, is very frequently modified by rains and fogs, in a way quite analogous to that I had occasion to observe in Síkkim. In Almóra 10^h P.M., in many a day, is found warmer than 4^h P.M., and very frequent too it is, that late in the evening it is cooler than early in the morning; then heavy fogs are formed during the night.

In the *View of Rámpur*, Plate 3 of the Atlas, the terrace where my people are seen resting is the border where the natural slopes of the mountain trace the walls of the steeper channel eroded by the water, and this can easily be followed higher up too, when examining the forms presented by the mountains. The sky in this view shows the bright aspect of a break, soon to be succeeded again by rains. The snowy ridges are here only peaks of a moderate height—moderate for these regions, as they do not exceed 19,000 to 20,000 feet. Of the snowy ranges some panoramas, which will also be represented in the Atlas, show us views much more grand; though, as to the charms of the mightiest forms of the peaks, combined with the most brilliant colours of the dales, what I had seen in the eastern Provinces remained unsurpassed, yea unattained.

But a characteristic distinction of these regions of the Himálaya is best seen in the *general elevation,* the lines as well as the shades being more uniform, and, in consequence, increasing the force of the impression. Such was the predominant effect they made upon me; nevertheless, it is with hesitation I venture a definition which I feel myself to be insufficient, when recalling to my mind the peculiar beauty of these regions; any attempt at verbal description must appear imperfect when combined with personal recollection. In these western provinces, in addition, climate allows one to study for weeks the charms which, in the foggy east, must be compared and seized in moments.

The *Absolute Extremes* had to be combined from readings of the ordinary thermometer. The hottest hour was sometimes noon, sometimes 2^h 40^m, or even as late as 4^h P.M., varying with the weather and the station. As for the year 1854, contemporaneous materials were at hand for most of the stations. I preferred combining these values to selecting the extremes from all the years in my books. The differences naturally would have become a little greater, the different years varying somewhat more in the mountains than in the plains, but the effect of the locality would have become less apparent than if I had combined only what belonged to the same period; and just this is one of the advantages obtained by comparing extremes, that we get our attention directed to local conditions better than by comparing the means only.

The stations before us show that the extremes diminish with height; they increase in the western stations, as we see in advancing from Landáur to Símla; we shall find it corroborated by Márri. The absolute maximum of heat is greatest through-

out in June, as in the plains—not July or August, as is the case in higher latitudes.

The sinking of the absolute minimum all along this part of the Himálaya in February 1854, coincided with a heavy fall of snow in the middle of this month;[1] when other years were examined, it was not met with again regularly, but it recurs frequently enough. In heights greater still, it appeared not improbable, from what I could gather from Tíbet, that, as in the higher parts of the Alps,[2] February may occasionally be colder than January, also in the mean.

Where, nearest the Tibetan crest, the rains are reduced to exceptional thunderstorms or hibernal snowfalls, the climate becomes extreme; and although we have for a winter above 10,000 feet only the verbal descriptions of the inhabitants, the means at least for the summer months (in the following tables) sufficiently corroborate it

Absolute Extremes, 1854.

Months.	Almóra, 5,546 feet.		Déra, 2,240 feet.		Landáur, 7,511 feet.		Símla, 7,057 feet.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
January	43	68	51	66	37	51	36	69
February	36	61	46	67	31	50	32	57
March	42	70	54	82	36	63	43	66
April	54	82	57	92	50	70	56	73
May	51	89	61	99	51	78	52	89
June	58	89	74	101	59	78	60	94
July	66	88	71	90	60	70	60	71
August	67	76	71	87	62	70	58	71
September	56	84	68	86	57	71	56	71
October	57	77	57	80	51	65	57	72
November	48	72	46	71	43	57	43	64
December	43	61	44	63	37	46	33	58

[1] It was the same at Darjíling, February 1837.

[2] "Phys. Geogr. of the Alps," Vol. I., p. 347.

Lohughát, or Rikhésar, in Kămáon.

Latitude North.	Longitude East Green.	Height.
29° 24′	80° 4′	5,649 feet.

1831, Jan. to March; 1830, April to Dec.
1835, Jan. to March; 1834, April to Dec. Lindsay, in Clelland, "Geology of Kumaon," p. 197.
The situation is open to the west, but enclosed on the other sides by mountains rising above it from 1,000 to 1,500 feet high.

Months.	1831-30.	1835-34.	General mean.	Months.	1831-30.	1835-34.	General mean.
	Mean of the months.				Mean of the months.		
January	45·2	43·9	44·5	July	69·3	73·0	71·1
February	43·6	48·0	45·8	August	69·1	72·3	70·7
March	52·3	52·3	52·3	September	67·3	70·2	68·7
April	59·3	62·6	60·9	October	63·2	62·9	63·1
May	66·6	65·5	66·0	November	52·3	51·6	51·9
June	68·4	73·7	71·0	December	47·3	45·5	46·4

Mean of the year 1831-30: 58·7 1835-34: 60·1

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
45·6	59·7	70·9	61·2	59·4

Havalbágh, in Kămáon.

Latitude North.	Longitude East Green.	Height.
28° 38′	79° 37′	4,114 feet.

The following means were communicated by the Commissioner, Mr. Batten, but I have no details in reference to the time of observation. Almóra, only 5 miles distant, shows itself to be less warm in summer, whilst in winter an accumulation of cold air appears to cause here a depression, in consequence of this station being lower.

Mean of the months.

January	47	May	73	September	75
February	55	June	76	October	69
March	61	July	78	November	60
April	66	August	79	December	52

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
50·8	66·6	77·6	68·0	65·8

ALMÓRA, in KĂMÁON.

Latitude North.	Longitude East Green.	Height.
29° 35′·2	79° 37′·9 ♁	5,546 feet.

1852-4. MORRIS. SR.; 9^h 50^m; N.; 2^h 40^m; SS. The place is situated on the edge of a long ridge; the tea plantations in its environs are lower, and lie on the slopes.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 34.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	43·0	55·1	49·0	40·1	47·6	43·8	47·1	53·9	50·5	47·5
February	50·9	64·2	57·5	50·2	66·7	58·5	45·9	51·1	48·5	54·8
March	50·3	61·0	55·6	56·5	71·9	64·2	51·9	59·1	55·5	58·4
April	58·0	71·9	64·9	60·3	74·1	67·2	61·5	66·2	63·8	65·3
May	63·5	76·3	69·9	65·9	78·4	72·2	64·3	79·1	71·7	71·3
June	70·1	80·7	75·4	72·6	82·1	77·3	69·0	76·6	72·8	75·2
July	69·5	75·9	72·7	70·9	77·3	74·1	69·2	76·1	72·6	73·2
August	68·5	77·1	72·1	70·2	77·5	73·8	70·5	72·3	71·4	72·6
September	68·3	77·9	73·1	68·1	78·5	73·3	68·9	72·9	70·9	72·4
October	58·5	75·7	67·1	61·0	70·6	65·8	62·4	69·9	66·2	66·4
November	53·0	67·4	60·2	55·5	67·1	61·3	53·2	62·3	57·8	59·8
December	48·0	58·5	53·2	48·8	62·4	55·6	46·4	55·2	50·8	53·2
Year	for 1852: 64·3			for 1853: 65·6			for 1854: 62·7			64·2

Isolated months (mean) 1855: Jan. 46·8.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
51·8	65·0	73·7	66·2	64·2

NAINITÁL, in Kămáon.

Latitude North.	Longitude East Green.	Height.
29° 23′·6	79° 30′·9	6,634 feet.

A. 1851-4. Means based upon the observations of Dr. PAYNE; hours of observation till 1853: SR. and 2h 40 P.M.; then 10h; 4h; 10h, later also SR. and extremes. The height given above is that of the Doctor's bángalow, where the instruments were put up; the height of the lake is 6,520 feet; but, though it is lower, the temperature is in general a little cooler there, from the evaporation of the water, as well as from the direction of descending currents of air during the night. SCHLAGINTWEIT, "Met. Mscr.," Vol. 34.

Monthly means for nine years, 1846-54, are contained in the Parl. San. Rep., Vol. I., p. 834. But the combination of the data seems not to have excluded the hours disturbing the mean, the values being 2° to 3° too warm. (The Nainitál Sanitary station originated in 1842.)

1851 to 1854. Monthly means.

January	42·5	April	59·3	July	65·3	October	58·1
February	46·4	May	64·1	August	66·0	November	55·0
March	55·5	June	69·6	September	63·2	December	48·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
45·8	59·6	67·0	58·8	57·9

B. 1846-53. The Parl. San. Rep., Vol. II., p. 196, contain the *annual* means for SR. and 2h P.M. for these eight years as follows; the mean I deduced from these perfectly agrees with the data for the last years communicated to me by Dr. PAYNE in detail.

1846 to 1853. Mean of the years.

Years.	SR.	2h P.M.	Mean.	Years.	SR.	2h P.M.	Mean.
1846	50¼	65	57·7	1850	51	64¼	57·6
1847	50¼	63¼	56·7	1851	52¾	66¼	59·5
1848	51½	65¼	58·4	1852	50¼	64¾	57·5
1849	54¼	66	60·1	1853	52	64½	58·2

General mean 1846 to 1853: 58·2

MÍLUM, in Kămáon.

Latitude North.	Longitude East Green.	Height.
30° 34′·6	79° 54′·8	11,265 feet.

1855. ADOLPHE and ROBERT. The observations were continued from June 3 to July 5; the following numbers are the means for this period. SCHLAGINTWEIT, "Beob.-Mscr.," Vol. 19.

1855.	SR.	4h P.M.	Mean.
June	56·6	70·4	63·5

Déra, in Găhrvál.

Latitude North.	Longitude East Green.	Height.
30° 18′·9	78° 1′·0ↄ	2,240 feet.

1851, June. Journ. As. Soc.

1850, 1852-4. Anderson, Barrister. 1851-3: 9^h 50′; N.; 2^h 40′; 4. 1854 and 5: SR.; 10^h; 4^h; 10^h.

Schlagintweit, "Met. Mscr.," Vol. 36.

The station is situated in a depression at the foot of the Himálaya, and is separated from the plains by the Seválik range.

Months.	1850			1851			1852			1853			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	....	....	....	52·3	62·6	57·5	49·6	56·6	53·1	54·4	62·1	58·2	54·5
Febr.	....	....	....	59·2	68·8	64·	56·1	65·6	60·8	48·1	59·7	53·9	59·6
March	....	....	....	60·2	69·5	64·8	62·6	73·7	68·2	54·9	73·3	64·1	65·7
April	66·3	81·7	74	68·2	79·7	74·	69·3	80·3	74·8	65·7	83·4	74·5	74·3
May	77·0	92·4	84·7	73·9	82·6	78·2	76·0	84·4	80·2	70·2	89·1	79·7	80·7
June	79·5	91·1	85·3	79·9	86·7	83·3	82·3	89·3	85·8	78·7	89·5	79·1	83·9
July	79·5	89·3	84·4	77·8	81·7	79·7	76·9	80·2	78·5	75·3	82·5	78·9	80·4
Aug.	76·2	81·1	78·6	77·1	79·7	78·4	77·2	80·4	78·8	74·5	80·6	77·6	78·4
Sept.	73·4	81·6	77·5	75·9	79·6	77·7	75·8	80·0	77·9	72·2	79·0	75·6	77·2
Oct.	....	....	....	68·6	74·9	71·7	66·7	76·3	71·5	61·9	74·4	68·2	70·5
Nov.	....	....	....	61·2	66·9	64·1	59·6	66·6	63·1	51·9	65·0	58·4	61·5
Dec.	....	....	....	52·7	59·0	55·8	53·3	60·8	57·1	45·9	58·7	52·3	55·1
Year			....	for 1851: 70·8			for 1852: 70·8			for 1853: 70·0			70·2

Isolated months (means). 1855: Jan. 49·0. 1856: June 86·1.

General mean of the seasons and of the year (1856 to 1859).

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
56·4	73·6	80·9	69·7	70·2

LANDÁUR, in Gărhvál.

Latitude North.	Longitude East Green.	Height.
30° 27′	78° 8′	7,511 feet.

1852-5. STEWART, JOHNSTON, LEATH. SR.; 2^h 40^m; SS.; and, later SR.; 4^h P.M.; 2^h 40^m, was corrected to 4^h from comparison with Massúri curves. 1851 was left out, the hours of observation being very irregular.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 36.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	37·9	40·2	39	31·7	33·1	32·2	42·0	44·9	43·5	37·8
February	47·2	49·6	48·4	43·7	46·8	45·2	34·6	37·7	36·1	43·2
March	44·5	47·4	46	49·5	53·8	51·6	45·9	50·4	48·2	48·6
April	53·8	59·3	56·5	53·7	58·7	56·2	56·1	61·8	59	56·5
May	60·1	63·8	62	59·2	66·4	62·8	61·9	68·1	65	63·0
June	62·3	67·7	65	67·3	71·5	69·4	66·2	70·3	68·2	67·5
July	61·5	67·5	64·5	63·2	65·8	64·5	62·8	66·0	64·4	64·5
August	61·5	64·5	63	62·5	65·8	64·1	62·9	66·4	64·6	63·9
September	62·2	66·0	64·1	61·1	64·0	62·6	59·6	63·9	61·7	62·8
October	55·0	58·5	56·7	52·5	57·2	54·8	51·4	53·1	52·2	54·6
November	47·3	49·0	48·1	47·0	57·3	52·1	44·7	50·7	47·7	49·3
December	38·0	41·7	39·9	43·2	46·2	44·7	39·2	41·9	40·5	41·7
Year	for 1852: 54·4			for 1853: 54·9			for 1854: 55·1			54·5

Isolated month (mean). 1855: Jan. 36·4.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
40·9	56·0	65·3	55·6	54·5

As a welcome verification of the Landáur readings Sir A. WAUGH sent us the means of April and May from *Banóg Hill*, 7,549 feet, only 8 miles distant, and nearly on a level with Landáur; "Beobachtungs-Mscr.", Vol. 19. The observations had been made for the determination of refraction, and include hourly variations from 6^h A.M. to 6^h P.M., also numerous observations during the night. The means resulting from ½ (SR. and Max.) are: Banóg Hill, 1853, April 54·3; May 62·1.

For comparison I add the values given for 1850 to 59 in the Paliamentary Reports, Vol. II., p. 134. I did not include them in the mean since the hours of observation and the mode of their combination is not detailed there; it is on an average 3° to 4° warmer, from March to July even 8° Fahr.

1854 to 1858. Mean of the months.							
January	44·25	April	65·41	July	70·08	October	56·88
February	43·33	May	70·61	August	67·68	November	49·13
March	56·76	June	73·18	September	65·95	December	44·31

MASSÚRI, in Gărhvál.

Latitude North.	Longitude East Green.	Height.
30° 27′·6	78° 3′·05	6,715 feet.

1855-6. Two series of observations could be combined for this station: one was made at the establishment of Sir ANDREW WAUGH in Mary Villa (to this place the geographical coordinates given above are referred); the other series was kindly made by Mr. MACKINNON. The hours of observation included SR.; 9^h; and 4^h, with additional variable hours.

SCHLAGINTWEIT, "Beob.-Mscr.," Vol. 19.

The numbers contained in the following table are the means deduced from both series.

Months.	1855	1856	General Mean.	Months.	1855	1856	General mean.
	Mean of the months.				Mean of the months.		
January	....	45·2	(45·2)	July	67·1	66·4	66·7
February	....	48·2	(48·2)	August	63·2	65·3	64·2
March	50·1	57·0	53·5	September . . .	65·0	64·9	64·9
April	63·1	67·2	65·1	October	60	64·0	62·0
May	67·3	69·2	68·2	November	....	53	(53)
June	65·3	64·2	64·7	December	....	46	(46)
				Year	....	55·9	58·5

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
46·5	62·3	65·2	60·0	58·5

In order to show how gradually the change of temperature varies day by day within the yearly period, I give in the following table the observations made at 9^h A.M. (as being the hour least differing from the mean of the day) from January to October at Mary Villa; November and December I add from Mr. MACKINNON.

Variation of temperature within the yearly period. Massúri, 1856, 9^h A.M.

Date.	Jan.	Febr.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	39·2	....	60·3	67·2	....	68·5	62·8	65·6	65·2	60	48
2	51·2	....	....	61·3	....	61·5	66·7	....	67·5	65·2	60	49
3	53·4	....	58·1	63·0	....	58·7	64·1	....	64·6	64·8	60½	44
4	51·5	52·1	60·8	61·0	....	63·0	64·8	64·8	65·6	....	60½	40
5	....	47·8	61·1	....	64·8	65·1	....	63·7	65·6	....	57	41½
6	....	49·0	59·4	....	68·0	64·1	....	65·6	....	67·7	55	....
7	47·2	50·8	61·3	67·0	71·0	....	66·8	64·9	....	65·9	54	43
8	51·6	47·8	....	69·0	71·5	....	65·2	64·7	65·7	64·6	52½	....
9	47·5	....	....	69·0	79·2	57·8	67·3	....	68·8	64·3	49	44
10	48·7	....	62·2	66·0	....	69·3	64·5	....	67·2	65·9	52½	46
11	52·0	52·8	63·0	63·5	....	62·3	....	66·3	64·2	....	53	47
12	....	53·8	63·8	....	74·0	57·8	....	64·9	66·8	....	53	46
13	....	51·3	62·8	....	73·7	....	....	67·4	....	65·6	51	43
14	47·0	42·5	60·8	61·2	70·5	....	67·9	66·3	....	65·9	53	43
15	48·8	42·5	....	61·0	65·5	....	66·8	63·2	64·3	63·6	53	43
16	49·7	....	....	65·5	65·0	62·5	66·4	....	63·0	62·5	....	42½
17	50·9	....	57·8	69·3	....	60·5	65·4	....	65·0	66·8	53	42½
18	46·2	50·8	52·3	70·2	....	64·5	66·3	63·8	67·8	....	50	44
19	....	53·0	54·0	....	69·4	65·0	....	71·8	61·3	....	48½	45
20	....	51·3	44·5	....	68·7	67·0	....	66·3	....	63·3	50	44
21	....	57·2	....	67·5	69·9	....	64·2	64·2	....	60·3	46½	42½
22	46·4	56·6	....	68·4	71·9	....	70·4	66·0	59·7	62·8	47	....
23	44·6	....	....	70·4	62·1	69·5	65·5	....	59·6	64·1	47½	50
24	46·8	....	56·7	71·2	....	69·2	72·0	....	64·9	64·0	45½	51
25	41·5	52·0	54·7	72·4	....	66·3	71·3	66·4	65·5	....	50	48
26	....	58·7	56·0	....	67·0	65·1	....	63·9	65·7	....	51	47
27	....	54·0	59·8	....	65·4	67·4	....	63·2	....	64·1	56	45½
28	....	54·7	62·1	57·5	66·7	....	66·8	66·2	....	65·1	52½	49
29	44·2	56·0	....	65·0	68·0	....	68·6	65·7	67·3	66·0	48	....
30	32·6	....	....	61·4	67·1	67·6	66·1	....	62·8	70·3	....	48
31	36·2	....	61·4	....	....	....	65·2	....	....	70·1	....	41
	46·7	51·1	58·6	65·5	66·0	64·2	66·9	65·3	64·9	65·1	52·5	45·1

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
47·6	63·4	65·5	60·8	59·3

For three other places of Gărhvál I can give the means deduced from observations made in connection with my brothers' journeys in 1855, as during the time they passed in Gnari-khórsum, observations had been continued by part of their establishment. SCHLAGINTWEIT, "Beob.-Mscr.," Vol. 19.

JHÓSIMATH, in Gărhvál.

Latitude North.	Longitude East Green.	Height.
30° 34′	79° 29′	4,724 feet.

1855. The observations were made by ROBERT near the temple of Vishnupreág, July 26, 27, 28, and 29. Clouds and rain throughout.

	SR.	4h P.M.	Mean.
July 26-29	64·5	75·2	69·8

BÁDRINATH, in Gărhvál.

Latitude North.	Longitude East Green.	Height.
30° 46′	79° 20′	10,124 feet.

1855. August 1 to 31. In the beginning rainy, then cloudy.

	SR.	4h P.M.	Mean.
1855 August	50·1	66·0	58·0

NÍTI, in Gărhvál.

Latitude North.	Longitude East Green.	Height.
30° 48′	79° 34′	11,464 feet.

1855 July. Notwithstanding its great elevation, this village is situated in a broad and well-protected depression; a local configuration which remarkably raises the temperature in summer.

	SR.	4h P.M.	Mean.
July	60·4	70·5	65·4

SABÁTHU, in Símla.

Latitude North.	Longitude East Green.	Height.
30° 58′·5	76° 58′·5 ♁	4,205 feet.

1850. MAC FARLANE. SR.; Max.; SS. The time was not kept very accurately.
1852. BEADE. SR.; 2^h P.M.; SS.

In order to obtain the mean for 4^h P.M. from these data I had to apply a correction; I calculated it from the Símla observations.

For 1850 I deduced 4^h P.M. from $\frac{\text{Max.} + \text{SS.}}{2}$; for 1852 from 2^h P.M.—0·5° Fahr.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 37.

Months.	SR.	4^h P.M.	Mean of the month.	Months.	SR.	4^h P.M.	Mean of the month.
1850.							
August	73·0	76·3	74·6	October	67·5	73·0	70·2
September	73·2	77·5	75·3	November	61·5	66·8	64·1
1852.							
June	78·3	84·2	81·2	July	76·1	79·2	77·6

DĂGSHÁI, in Símla.

Latitude North.	Longitude East Green.	Height.
30° 53′·1	77° 2′·2	6,025 feet.

1852, 3, 4. COWEN (?—signature indistinct, H. M. 98th. Regt.). REDWAY; GRANT. SR.; 10; 4; SS.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 37.

Months.	1852			1853			1554			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	....	....	....	38·1	40·0	39	....	....	....	39
February	....	....	....	49·2	58·2	53·6	....	....	....	53·6
March	....	....	....	55·4	60·6	58	....	....	....	58
April	55·4	65·0	60·2	58·7	68·7	63·7	61·4	71·4	64·4	63·4
May	62·5	73·9	68·2	64·5	74·9	68·7	68·9	71·2	70	69
June	70·1	78·6	74·3	70·7	75·0	72·8	73·1	78·5	75·8	74·3
July	65·1	73·2	69·2	67·8	70·0	68·9	65·1	70·6	67·9	68·6
August	64·8	70·4	67·6	68·1	68·7	68·4	65·0	69·6	67·3	67·8
September	64·5	69·1	66·8	64·1	67·6	65·9	66·9	67·2	67	66·6
October	57·7	69·5	63·6	....	....	....	....	....	....	63·6
November	49·6	61·6	55·6	....	....	....	54·9	59·8	57·4	56·5
December	42·4	51·0	46·7	....	....	....	....	....	....	46·7
Year			....			....			....	60·6

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
46·4	63·5	70·2	62·2	60·6

Kotghár, in Símla.

Latitude North.	Longitude East Green.	Height.
31° 19′	77° 28′	6,412 feet.

1819-21. Details unknown; Parl. San. Rep., vol. I., p. 834; not included in the mean.

1855-6. Gúdru Mall, Deputy postmaster. SR.; 8; 12; 4.

The hours were not quite regularly kept; but the correction to be applied could be calculated from the Símla observations.

Schlagintweit, "Met. Mscr.," Vol. 37.

Months.	1819-21.	1855			1856			General mean.
	Mean of the month.	SR.	4h P.M.	Mean of the month.	SR.	4h P.M.	Mean of the month.	
January	40	....	....	....	35·5	49·3	42·4	42·4
February	45	....	....	....	41·1	54·7	49·9	49·9
March	..	42·3	57·0	49·6	51·3	66·0	58·6	54·1
April	..	49·5	64·7	57·1	56·3	71·6	63·9	60·5
May	68	62·2	75·7	68·9	63·5	75·2	69·3	69·1
June	72	65·9	79·7	72·8	63·2	75·3	69·2	71·0
July	71	63·9	72·2	68·0	65·3	73·0	69·1	68·5
August	67	64·3	73·0	68·6	64·5	70·2	67·4	68·0
September	65	63·5	70·2	66·8	61·0	71·0	66	66·4
October	56	48·3	61·2	54·7	53·5	67·5	60·5	57·7
November	51	41·0	57·9	49·4	....	....	....	49·4
December	..	37·0	56·0	46·5	....	....	....	46·5
Year	..			....			....	58·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
46·3	61·2	69·2	57·8	58·6

KĂSSÁULI, in Símla.

Latitude North.	Longitude East Green.	Height.
30° 54′	77° 3′	6,650 feet.

1852-3. McNAB; GAMMIE. SR.; 9^h 50^m; N.; 2^h; 4^h; SS.
1856-7. Assistant Commissioner TAYLOR. 7^h; 1^h; 7^h.

For the latter period $\frac{7+1}{2}$ had to be taken to deduce the mean.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 37.

Months.	1852			1853			1856			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	7^h A.M.	1^h P.M.	Mean of the month.	
January	....	....	....	34·8	37·8	36·3	....	....	....	39·6
February	....	....	....	37·9	41·4	39·6	....	....	....	39·6
March	....	....	....	47·9	61·7	54·8	....	....	....	54·8
April	....	....	....	50·2	58·1	54·1	....	....	....	54·2
May	66·9	71·1	69·0	55·8	63·3	59·5	....	....	....	64·2
June	65·8	74·9	70·3	65·2	69·5	67·3	67·7	72·7	70·2	69·3
July	69·1	71·7	70·4	60·9	65·8	63·3	66·6	69·5	68·0	67·2
August	67·1	69·2	68·2	64·1	64·7	64·4	63·6	66·5	65·0	65·9
September	68·7	70·9	69·8	62·9	69·2	66·0	62·0	64·9	63·5	66·1
October	62·3	66·8	64·5	56·3	60·2	58·2	57·7	63·7	60·7	61·1
November	50·9	53·0	52·9	....	....	....	51·8	57·5	54·6	53·8
December	41·3	44·3	42·8	....	....	....	46·5	50·5	48·5	45·6
Year			....			....			....	56·8

Isolated month (mean). 1857: Jan. 42·7.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
41·6	57·7	67·5	60·3	56·8

SÍMLA, in Símla.

Latitude North.	Longitude East Green.	Height.
31° 6′·2	77° 9′·4♂	7,057 feet.

1850-4. MACANNON; MARTIN; at the Staff Dispensary. SR.; Noon; later also 4^h.

1856. RADHAKÍSHEN, at the Government-school: 6; 10; 2; 4; 10; The schoolmaster had been charged to continue the reading of the instruments we had put up ourselves; his observations were registered with great care and accuracy.—Noon in the first series was reduced to 4^h P.M. from the curves of daily variation deduced from the Government-school series.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 37 and "Beob. Mscr.," Vol. 19.

Months.	1850			1851			1852			1853			1854			1856			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	....	....	....	35·4	44·0	39·7	40·0	49·8	44·9	....	....	....	43·0	57·6	50·3	....	....	....	45·0
Febr.	....	....	....	39·1	47·1	43·1	45·1	59·1	52·1	44·3	58·9	51·6	46·0	62·0	54·0	....	....	....	50·2
March	....	....	....	48·9	57·9	53·4	43·6	52·2	47·9	48·7	64·0	56·3	47·0	58·0	52·5	....	....	....	52·5
April	50·0	62·0	56·0	....	....	....	54·0	65·8	59·9	53·1	63·6	58·3	58·3	64·0	61·2	....	....	....	58·9
May	61·7	67·4	64·5	....	....	....	54·6	68·9	61·8	60·2	73·4	66·8	58·4	76·3	67·3	65·8	72·2	69·0	65·9
June	63·7	70·7	67·2	....	....	....	62·4	77·7	70	67·8	77·8	72·8	63·1	79·1	71·1	60·8	73·3	69·5	70·1
July	64·0	69·4	66·7	....	....	....	63·2	67·9	65·6	63·8	68·4	66·1	62·5	68·8	65·6	62·6	69·5	66·0	66·0
Aug.	61·9	67·1	64·5	....	....	....	61·9	64·9	63·4	62·3	69·7	66·0	60·4	67·4	63·9	60·5	65·5	63·0	64·2
Sept.	59·9	69·4	64·7	....	....	....	61·4	67·4	64·4	61·0	70·5	65·7	57·4	68·3	62·8	57·1	65·3	61·2	63·8
Oct.	53·8	65·3	59·5	53·8	67·6	60·7	....	....	....	54·4	66·3	60·4	52·1	66·5	59·5	49·7	63·3	56·5	59·3
Nov.	48·0	60·6	54·3	....	....	....	46·5	58·4	52·4	48·7	62·8	55·7	46·7	58·5	52·6	42·9	56·9	44·9	52·0
Dec.	42·6	53·9	48·2	....	....	....	41·5	52·2	46·8	....	....	....	38·0	49·4	43·7	39·2	49·7	44·4	45·8
Year			....			....			....			....	for 1854: 58·7					....	57·8

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
47·0	59·1	66·8	58·4	57·8

GROUP III: KÚLU, CHÁMBA,

LAHÓL, KASHMÍR, MĂRRI, IN THE HIMÁLAYA.

Sultánpur.—Kángra; Dalhousie.—Kárdong.—Srinăger.—Mărri.

As we proceed to the north-west the Himalayan climate shows alterations not unlike the difference between Hindostán and the Pănjáb; the variation of the temperature within the early period becomes greater, and on an average the rains decrease in intensity and duration, though for the very outer ranges they remain still heavy enough.

As the country the most characteristic for the central region, and at the same time the most pleasant to begin with, I name *Kashmír*.[1] In reference to climate it can be considered one of the spots of the globe certainly most convenient to any type of human races, being mild and not too hot.

The charms of the *spring* of Kashmír have become widely spread already by Indian poetry; *summer*, even up to the middle of June, is still fresh all night, the mornings being as low as 60° to 63° Fahr., the mean of the day is 70° to 75° Fahr.; only about 6 weeks of July and August, a period sufficient for the maturation of delicious fruit and most precious crops, have an average temperature equal to that of the southern parts of France. Thunder-storms in summer are not unfrequent,

[1] Concerning its advantages as a Sanitarium see p. 471.

though their force is broken by the surrounding chains and peaks; they are of longer duration than those in Europe, but weak when compared with what are seen in the tropical regions; and the rains, with interruptions of five to six days, are equally refreshing and beneficial to the crops.

The sun is powerful here, as was to be expected in latitudes from 33° to 35°; and in the days of interruption of the summer-rains and thunder-storms it is felt the more. Houses, tents not the least, rocks, as well as the surface of the ground, then get thoroughly warmed through, and from the middle of the day even trees allow one to feel it, their shade being frequently little protection.

Then the temperature of the free air, determined by a thermometer[1] in peripheric motion, swung under a double clad umbrella, was generally found to be 2° to 3° Fahr. cooler than a thermometer put up in the shade of the tree, where it was heated by the very temperature of the tree exposed to the full power of the sun. In the morning till about 10 o'clock the same localities under trees are still cooler, the temperature being still under the influence of the night and early morning hours. In the tropics, under those Indian fig-trees, covering quite a little territory with ramifications supported by their vertical branches, I had found analogous differences greater still. In Europe the action of the sun is neither powerful nor, generally, uninterrupted enough to produce such variations so regularly; but in the hot July of this summer, 1865, I had occasion to observe it also under large pear and nut trees round the Jägersburg, in Franconia, more frequently by their being "too cool" in the morning than their being overheated in the afternoon.

The very hottest month excepted, nevertheless, a European may pass in Kashmír a whole day *en route*, the air itself being refreshing enough as long as not perfectly calm, and under a good *marrow* hat (*sola-tópi*) the head is sufficiently secured.

In the beginning of July a sudden rise of the rivers occasionally limits the excursions; it coincides with the final and rapid disappearing of snow from the neighbouring heights on the north.

In *autumn*, and throughout the *winter* too, heights likes those of the environs of Srinâger—a beautiful level ground surrounded by moderate ridges—have a climate quite suitable to Europeans. The accumulation of cold air is remarkably reduced[2] in the greater part of Kashmír by the valleys being mostly wide and open. Also large lake-basins

[1] Compare p. 32 for details.

[2] Heavy snow-falls, but not of long duration occasionally take place in January and February.

are frequent; but only few of them have any water in them, and this is very shallow: such are the Vúler and Chunár lakes. The lakes now dry have been emptied by that gradual draining effect of erosion which I had occasion to mention in describing the environs of Kathmándu.

Such open valleys, being more exposed to the action of the sun than the bottoms of narrow valleys, have a peculiar power in cutting off the currents of air descending from the higher regions of snow and névé, and breaking their local effect.

Natives, however, unprotected in draughty huts, and without any substitute for a fire-place, except a basin filled with charcoal in their rooms, occasionally suffer from cold, but not enough to induce them to erect better habitations, notwithstanding their technical abilities in many branches of architecture and manufacture.

The *Panoramic View of Kashmír* in the Atlas (Plate 18) was taken from the "floating gardens," about in the centre of the Chunár lake, as the view from this point could be considered to include the features here most characteristic: a lovely, cultivated country, continuous but moderate elevations, and absence of large groups of snowy peaks.

The scenery varies rapidly, however, as soon as we ascend one of the northern ridges in sight, whence we see at once the chains of the western Himálaya, overtopped in many a part by an isolated peak of Bálti and Ladák.

At *Mårri*, the principal station of the outer ranges, the total amount of rain has decreased when it is compared with the eastern parts of the Himálaya, but its duration is long enough—from the middle of June till the middle—frequently till the end—of September. Even in the early part of October Mårri is visited by storms with hail or cold heavy showers.

The trees surrounding the station make it damp, more so than might have been expected from the other conditions of its situation.

But the most important benefit of this place is the easy access to the same, for protection from the heat of the Pănjáb. In the cool season many days with a mean little differing from 32° become unpleasant to a European, even if not an invalid.[1]

[1] For those who can enjoy a change of station also in the cool season, Raulpíndi is known as one of the most pleasant and healthy. Compare p. 294.

In the following table of the extremes I chose 1854, as in the preceeding group. The months marked by an asterisk had to be taken from the year 1855.

Months.	Min.	Max.	Months.	Min.	Max.
January*	23	48	July	59	94
February*	27	58	August	62	80
March*	26	79	September	59	76
April	37	78	October*	40	71
May	46	87	November	31	56
June	57	90	December	33	50

SULTÁNPUR, in Kúlu.

Latitude North.	Longitude East Green.	Height.
31° 57′·8	77° 5′·8	3,948 feet.

1857. MAHARÁJ SINGH. SR. N. 2^h P.M. The instruments were left there and put up by our brother ADOLPHE: Major HAY, so well known by his labours for the civilisation and exploration of Kúlu, kindly forwarded me later the Journals to Europe. As a peculiar modification, I may add that I got those meteorological journals written in Hindostáni, the only case for any of the stations here analysed except the various shorter series of corresponding observations executed by our native assistants.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 39, Appendix.

Months.	1857			Months.	1857		
	SR.	4^h P.M.	Mean of the month.		Mean Min.	Mean Max.	Mean of the month.
May	55·5	86·1	70·8	September	63·0	78·6	70·8
June	61·6	83·8	72·7	October	45·0	72·9	58·9
July	68·9	81·5	75·2	November	37·9	63·4	55·6
August	68·6	87·7	78·1				

Mean of the seasons.

June to Aug.	Sept. to Nov.
75·3	61·8

Kángra, in Chámba.

Latitude North.	Longitude East Green.	Height.
32° 5′·2	76° 14′·45	2,553 feet.

1852-5. Leath; Walter; Williams; Harding. For 1853 I had two series, of which I took the mean.

Schlagintweit, "Met. Mscr.," Vol. 38.

Barnes's "Report on the Kángra Settlement," Lahore, 1855, contains much ethnographical and political information, but no positive data about climate.

Months.	1852			1853			1854			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
January	41·4	56·3	48·8	40·2	51·1	45·6	48·7	56·8	52·8	49·7
February	49·0	65·3	57·2	58·0	61·1	59·5	46·5	52·4	49·5	55·4
March	50·5	62·7	56·6	59·4	74·0	66·7	55·6	73·2	64·4	62·6
April	59·2	77·9	68·5	62·8	73·7	68·3	....	....	....	68·4
May	69·6	84·0	76·8	72·3	86·7	79·5	72·5	88·7	80·6	79·0
June	75·4	92·7	84·1	83·0	94·2	88·6	78·6	90·4	84·5	85·7
July	75·3	85·2	80·2	76·4	78·2	77·3	74·5	79·5	77	78·2
August	73·5	81·8	77·6	71·5	76·5	74·0	73·3	79·6	76·4	76·0
September	71·3	83·5	77·4	69·5	78·0	73·7	70·5	77·5	74·0	75·0
October	60·8	81·5	71·2	62·6	74·0	68·3	58·6	67·9	63·2	67·6
November	53·4	69·2	61·3	57·5	65·3	61·4	55·7	62·7	59·2	60·6
December	43·8	59·5	51·6	52·5	61·5	57·0	49·9	56·1	52·5	53·7
Year	for 1852: 67·6			for 1853: 68·3					....	67·6

Isolated months (mean). 1855: Jan. 51·5.

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
52·9	70·0	80·0	67·7	67·6

Dalhousie, in Chámba.

Latitude North.	Longitude East Green.	Height.
32° 32′	76° 0′	6,850 feet.

1860, June to Oct. Drysdale. SR.; N.; SS. I took for the mean $\frac{1}{2}$ (SR. + N.). As it might be not uninteresting to have an estimate of the mean anual temperature for this new Sanitary station, I added for the other months, in brackets, an approximate value, calculated from Símla and Mårri by comparative reference, of the data before me.

The considerable decrease of the amount of rain and moisture is to be mentioned here, as it is so much in favour of the selection of this place.

1860. Mean of the month.			
January	(40)	July	75·3
February	(46)	August	70·7
March	(52)	September	65·6
April	(60)	October	56·8
May	(70)	November	(54)
June	76·2	December	(45)

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
(43·7)	(60·6)	74·1	(58·8)	(59·3)

KÁRDONG, in Lahól.

Latitude North.	Longitude East Green.	Height.
32° 33′·8	77° 0′·6	10,242 feet.

1855, May to October; observations at 9^h; N.; SS.; by the missionaries Messrs. HEYDE and PAGEL. The remaining months I added from isolated observations which Máni, our assistant, had made during the winter 1855-6, at equal heights, for approximatively completing the type of the annual variation.

SCHLAGINTWEIT, "Met. Mscr.," Vol. 19.

1855-6. Mean of the months.			
January	24	July	63
February	36	August	60
March	44	September	52
April	47	October	46
May	49	November	37
June	54	December	27

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
29·0	46·6	59·0	45·0	44·9

SRINÁGER, the Capital of Kashmír.

Latitude North.	Longitude East Green.	Height.
34° 4′·6	74° 48′·5	5,146 feet.

1856. Our own stay supplied me detailed observations for September, October, and November; for the other months the values given below were based on isolated data of parts of our etablishments (SR. and 4^h P.M.) and of previous travellers; amongst these latter I name JAQUEMONT, HÜGEL, VIGNE, and CUNNINGHAM. Mr. BRERETON, Political agent at Kashmír in 1856, also materially facilitated my collecting, besides the thermometrical data, varied information in connexion with climate and periodical phenomena of vegetation.

SCHLAGINTWEIT, "Beob.-Mscr.," Vol. 19.

1856. Mean of the months.

January	40	April	56	July	73	October	57
February	45	May	60	August	71	November	54
March	50	June	70	September	63	December	42

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
42·3	55·3	71·3	58·0	56·8

For comparison in reference to sanitary purposes, some words and figures may be added about southern Europe and the African coast of the Mediterranean. As I cannot enter here into all the varieties of climate, I have selected three stations only, differing in latitude and longitude, to show the temperature.

Southern Europe and northern coast of Africa.

Geographical co-ordinates.

	Latitude North.	Longitude East Green.	Height:
Montpellier	43° 36′	3° 53′	106 feet.
Rome	41° 54′	12° 25′	170 „
Algiers	36° 47′	3° 3′	L. a. L. S.

Mean of the months, seasons, and year.

Months.	Montpellier.	Rome.	Algiers.	Months.	Montpellier.	Rome.	Algiers.
January	42·1	45·0	52·9	July	78·4	75·9	75·2
February	44·8	47·3	54·7	August	77·0	75·7	75·4
March	48·9	51·6	56·1	September	70·3	70·0	73·2
April	57·4	57·9	59·0	October	61·9	64·9	68·6
May	64·4	65·3	66·0	November	50·5	53·4	61·9
June	72·5	71·2	71·6	December	45·9	47·8	55·4
Seasons.				Seasons.			
Dec. to Febr.	44·3	46·7	54·0	June to Aug.	76·0	74·3	74·1
March to May	56·9	58·3	60·4	Sept. to Nov.	60·9	62·8	67·9
				Year	59·5	60·5	64·1

Nice and Mentone (the latter recently favoured so much by medical advisers as being the less rough of the two); Madeira, as mild and moist; Pau, in France; Palermo in Sicily; might be added as the stations most frequented in winter.

Kashmír is less hot throughout, and in winter only two degrees cooler than the south of France.

Mårri, in Mårri.

Latitude North.*	Longitude East Green.	Height.
33° 51′·0	73° 22′·7 ⊨	6,963 feet.

1852, 4, 5, 6. Inglis; Jephson; Thompson; Moss. SR.; 10; 4; 10. For a part of 1854 I had two series independent of each other, of which I took the mean.

Schlagintweit, "Met Mscr.," Vol. 38.

For various and valuable local details see Gordon, "Topography of Murree," Jour. As. Soc. Bengál, 1854, p. 461.

Months.	1852			1854			1855			1856			General mean.
	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	SR.	4^h P.M.	Mean of the month.	
Jan.	....	....	....	....	....	....	33·9	37·9	35·9	36·7	43·2	40	37·9
Febr.	....	....	....	....	....	....	40·9	53·7	47·3	36·7	46·2	41·4	44·4
March	....	....	....	....	....	....	38·3	54·8	46·6	46·0	63·0	54·5	50·6
April	49·4	56·6	53	49·0	57·5	53·2	44·9	64·7	54·8	56·9	66·6	61·8	55·7
May	56·0	61·1	58·5	54·5	68·0	61·3	55·5	73·7	64·6	61·2	76·1	68·6	63·3
June	65·0	71·1	68	64·9	78·9	71·9	69·8	77·6	73·7	64·9	76·5	70·7	71·1
July	64·9	70·0	67·5	60·2	70·0	65·1	67·3	71·6	69·4	63·4	73·9	68·7	67·7
Aug.	63·0	65·0	64	69·6	75·8	72·7	....	....	....	63·2	70·0	67·1	65·9
Sept.	61·0	65·0	63	61·5	67·0	64·2	69·5	73·9	71·7	63·0	75·3	69·2	67·7
Oct.	55·0	66·0	60·5	....	....	....	55·9	64·6	60·2	54·0	65·7	59·9	60·2
Nov.	....	....	....	43·5	47·6	45·6	44·3	62·8	53·6	....	....	....	49·6
Dec.	....	....	....	38·4	44·1	41·3	42·5	48·0	45·2	....	....	....	43·2
Year			....			....			....			....	56·4

General mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
41·8	56·5	68·2	59·2	56·4

GROUP IV: TÍBET AND TURKISTÁN.

Kánam; Spíti; Leh; Eastern Environs of Ladák.—Skárdo.—Búshia; Yárkand.

In passing now from the meteorological analysis of the south side of the Himálaya to that of Tíbet, a region of excessive dryness presents itself.

The want of atmospheric moisture, of rain and springs, also considerably limits the number of population in every part of Tíbet; as we approach the crests of the Karakorúm and Kuenlúen, to the North, the country becomes absolutely deserted. The temperature, notwithstanding the great elevation of the ground, is warmer in Tíbet than might be expected, such localities excepted where the form of the ground favours the accumulation of currents of cold air descending from the high regions; the scarcity of clouds, in a great measure the quantity of naked rock and soil exposed to the action of the sun, and, as we shall see in the concluding comparative considerations, not less the great *extent of elevated ground* all round, are causes which here operate to reduce the rapidity of the decrease of temperature with height.

The climate of *Eastern Tíbet*, from the information we could obtain from caravans and traders in Assám, Bhután, Gnarikhórsum, may be considered to differ but little, in reference to temperature, from Bálti, being nearly as dry, however, as Ladák. Independent of the materials collected in the mountainous regions, the connection already of the isothermal lines for the year in the Pănjáb with those in Assám showed (Meteorology, Plate 2) that from conditions of a more general nature a sinking of the lines

of about 4 degrees of latitude takes place within the longitude from 70° East to 95°. This, too, confirms the supposition that the temperature round Lhássa cannot differ much from that, at equal height, near Skárdo. The previous researches made by CAMPBELL, HODGSON, and HOOKER, gave me reason to expect the same. HUC and GABET,[1] notwithstanding the bold travels they had made, brought home no observations and altogether not many positive details. When near Lhássa, in March, they found the rivers free from ice. Snow is said to fall as low as Lhássa[2] every winter, but it never becomes deep, though the winter months are the period of the year to which the atmospheric precipitation is chiefly limited. Hail is not unfrequent in summer.

The *Missions étrangères de Paris* continue full of ardent zeal in their endeavours to propagate the Christian faith in Tíbet along a line directed to the very centre of Buddhism.

In 1854 RENOU etablished a missionary settlement in Bónga, a narrow valley in the district of Tsárong, drained by an affluent on the left side of the Dibóng. It is reported to be ten days' march distant from Assám, three days' march from Yunán (the Chinese province to the east), and ten days' march from Mangan (the Kiang-ka of the Chinese). From these data we deduce the position of Bónga[3] to be Lat. N. 28° 30′; Long. E. Gr. 96° 20′; height about 8000 feet. It is very much to be regretted that though 11 years in Tíbet, they had not even one thermometer.[4]

Tibetan priests, when I asked them about the physical instruments mentioned in CSOMA's dictionary, told me they were well aware of their use at Lhássa. They spoke of a *Tang doi chād*, a cold and heat measure, or thermometer; *Yángchi chād*, a lightness and heaviness measure, verbally described to be connected with atmospheric pressure, not a balance. Also a *Kamchéri chād*, or dryness and moisture measure, an hygrometer, was mentioned as being in use; one of these I got shown me at Hémis, and

[1] HUC and GABET, "Souvenir d'un voyage dans la Tartarie, le Tíbet et la Chine, pendant les années 1844, 1845, 1846," Vols. I. and II., 1853.

[2] Comp. "Description du Tibet, traduit du Chinois par KLAPROTH;" where also the principal periodical phenomena of vegetation are detailed. Nouv. Journ. Asiatique, IV, p. 138.

[3] For an analysis of the various reports see EMIL SCHLAGINTWEIT, "Die Lage von Bónga," in Globus, 1865.

[4] The news brought by Shanghae Papers in 1864 of French Missionaries having again reached Lhássa have not been confirmed; HUC and GABET were the latest who succeeded in reaching it. — The news which arrived, October 1865, at the *Missions etrangères*, at Paris, state, that also a recent attempt to reach Bónga met with great obstacles on the part of the Chinese. New missionaries sent out had been stopped in their journey, as they relate in their last letter.

found it to be a plain vegetable fibre occasionally changing its form when a great alteration had taken place; *tout comme chez nous*, not a very long time ago. The instruments used as thermometers or barometers I did not get sufficiently described to form any idea of the principles employed.[1]

For *Central and Western Tíbet* we have somewhat more positive information; the works of earlier travellers already contain various numerical data, considerably increased by the more recent works of CUNNINGHAM, STRACHEY and THOMSON.[2] Our own observations include parts of the year 1855 for Gnarikhórsum, 1856 and 1857 for Western Tíbet, Bálti, and the regions adjoining, following the Karakorúm and Kuenlúen to the north, as far as Kashgár.[3]

Here, as in the preceeding groups, I had to limit myself to observations continued for some time, a traveller's diary registers, when *en route,* being too variable with time and locality for general conclusions. Isolated observations we made are found in Vol. II., in connection with the determinations of heights.

As a type for Tibetan climate (varying but with height) Leh may be chosen for description. The rarefaction of the atmosphere produces in reference to temperature, as shown in the numerical tables following, a great daily range; also within the yearly period the variation is considerable.

In *winter* the perfect clearness of the sky for weeks is felt as heavily by the cold it produces every night as the want of firewood. Snow is the rule every winter all over the crests, but it is not quite regular for situations as low as that of Leh; a dry winter is feared most by the inhabitants on account of its deleterious effects upon their few fruit-trees. Atmospheric precipitation being still more rare in

[1] The words given above are spelled phonetically, such as I *heard* them; the linguistic elements of the component parts, in conformity with the meanings, are the following.

Grang cold; *dro* warm; *'i* sign of the genitive case; *ts'had*, a measure.
Yang light; *bchi* heavy; *'i* sign of the genitive case;
skam dry; *gsher* moist; *gyi* sign of the genitive case.

In reference to the diversity between Tibetan speaking and spelling, see EMIL SCHLAGINTWEIT, "Buddhism in Tíbet," pp. 65, 82, 184, and "Könige von Tíbet," Abhandlungen der K. Bayer. Acad. der Wissensch., Bd. 10, Abth. 3, p. 794.

[2] The works containing meteorological observations are enumerated in the Tables of Literature, p. 22 and 26.

[3] Capt. MONTGOMERY, of the Great Trigonometrical Survey, had proposed to send *natives* beyond the Karakorúm to explore the country, and the enumeration of the instruments and orders they had received is contained in Journ. As Soc. Bengál, 1863, p. 175. No further communications about it have become known to me as yet.

summer, a year may occasionally pass with not so much as an inch of it in any form.[1] Cloudy days are somewhat more frequent in winter than in the other seasons.

As absolute extremes of temperature at heights and in situations like those of Leh, a minimum some degrees below 0° Fahr. is to be expected, according to STRACHEY,[2] in winter. The coldest temperature he had himself observed "was + 2° Fahr.; but as this was at $9\frac{1}{2}$ A.M. (10th of February, 1848), and the exposure of the instrument by no means perfect, it cannot be taken as the true external minimum; the weather, however, about that time was much colder than the average of the winter."

All the winter, from December to February, the frost lasts in the shade throughout the day.

In *Spring* the upper strata of the soil rapidly thaw, but the temperature of the ground down to some depth, being cooled so much during winter, without a sufficient protecting snow-cover, remains so low that it materially limits the development of the vegetation. The mean of March in heights of 12,000 does not rise much above 32° Fahr., in April and May the approach of summer is felt the more powerfully.

The town of Leh, although 11,532 feet high, is situated so that it is well protected by surrounding spurs against south-easterly and northerly winds, with its face fully open to the south, as shown in my view, Plate IX. of the Atlas; the local conditions therefore rather must contribute to make the climate milder than the average in corresponding heights, and this is chiefly observed in the periodic phenomena of vegetation in spring.

In *Summer* the want of shade is equally felt by the position of the sun in the middle of the day, when compared with the Alpine regions of Europe, as by the want of clouds and of a protecting cover of vegetation, such very large surfaces of *naked soil* being exposed to the unbroken action of the solar rays. At heights of 9,000 to 11,000 feet extremes of somewhat above 80° Fahr. in the shade may be observed, even where lateral radiation is carefully excluded. Precaution in this regard, and the use of the thermometer in peripheric motion for testing the place chosen for the instruments in a camp, may be said to be the more

[1] About the freezing of lakes and rivers remarks, also referring to the Kuenlúen, follow p. 526.

[2] "Physical Geography of Western Tíbet," p. 59.

important in Tíbet on account of the difficulty in finding protection by means of the neighbouring objects.

Also the rainy season of the plains and the outer ranges of the Himalayan chains is indicated occasionally, but for isolated days only, by a sudden appearance of clouds or by a soft hazy tint of the sky. Both are exceptional. When I was camping on the shores of the Tsomognalarí I first caught sight of a greater number of clouds in Tíbet, which I failed not carefully to copy, as something unusual.[1] Also the pale sky in ADOLPHE's *Panorama of the Mustágh Glacier* (Plate 10) must be quoted here as analogous, though differing in tint and form. Even rain falls occasionally in summer and then the more snow along the peaks and crests; in 1856 we had a drizzling rain at Leh from the 25th to the 28th of July, but the height of the clouds then still exceeded 17,000 feet; another rainfall occurred the 23rd of September.

Much more frequent it was to see the hygrometric instruments indicate a minimum little differing from absolute want of moisture, such as has since been found again in some of the excessive heights recently reached in balloon ascents.

The winds, also in summer, have lost the regularity of the Indian monsuns; the direction somewhat approaches a predominant type, varying with the seasons but they show nothing like constant intensity, days of perfect calm being frequently followed by weeks of storms; the power of the wind may then become even greater here than in the plains.

Also the uninterrupted action of the sun upon the soil has a peculiar effect upon the circulation of the air; it produces many local currents of great power; partly in the form of ascending or descending winds following the valleys, more frequently in the form of narrow columns of whirlwind carrying up sand and dust to a considerable height. I may also mention here a singular rustling frequently heard at great heights during the hottest period. It is well known to the natives under the name of the *Geg:*[2] they consider it quite unconnected with wind, as indeed it is heard only at times of perfect calm: but when watching the ground[3] a simultaneous motion in the

[1] Details about the direction follow in Vol. V.

[2] *bgegs*, evil spirit, diabolic being.

[3] A telescope, two glasses being taken out to make it inverting, but allowing one at the same time to look at objects at a very small distance, best facilitated my *seeing* the mechanical action.

pigmy vegetation at these highest places of grass and shrubs, and even in the grains of sand, could be observed as distinctly coinciding with the acoustic impression. This *Geg,* too, like the larger whirlwinds, is easily observed to pass over the ground in a solitary spiral motion, with narrow limits to the breadth of its path.

For the temperature of *Autumn* it is to be pointed out how warm September is when compared to Alpine stations of Europe. In Tíbet it appears scarcely to differ from the mean value of June: in Europe September is about equal to the mean temperature only of May, frequently cooler still. Also in October and November, notwithstanding the temperature having become already very low, the passes over into Turkistán—not those over the Himálaya—are open all the season. Some can be passed even all the winter.[1]

Towards the end of autumn fogs (*lang,* in Tibetan) occasionally appear; our own registers contain them only once for the valley of the Indus, in September 1856; at greater heights a cloud—a fog for the traveller passing through it—is less exceptional, being fixed there to the shady sides of the passes and peaks. Others are seen resting over the salt-water lakes where the water has not yet cooled down enough to correspond to the surrounding atmosphere. The Tibetans call these *Tsólang,*[2] lake vapours, and described them to me as not unfrequent; when I was along the lakes early in summer, I did not see any.

In *Bálti*, as we shall see when the curvature of the isothermal lines is analysed, the climate is less warm than in the central parts of Tíbet *at equal elevation*; but the *absolute* temperature is warmer, as the elevation of most of the valleys is less great. The moisture considerably increases here the farther we proceed to the west.

The *variability of climate*, as detailed above,[3] is much smaller in *India* than we are accustomed to expect it from Europe. In the outer ranges of the *Himálaya* it is not very great either; in the central and northern parts of *High Asia* the variability increases somewhat; but from observations and travelling experience, as well as from the data we obtained from the inhabitants concerning the periodical phenomena of vegetation,

[1] Compare the remarks about snowline and temperature at the conclusion of this volume.

[2] *m* ts'ho *r*langs (*m* ts'ho = lake; *r* langs = steam, rising vapour).

[3] See p. 23 of this volume.

such as germination, flourishing, and ripening, it appeared from the Tibetan rules of agriculture that the variability is much smaller in Tíbet than in Europe: the changes are neither so great nor so sudden.

In the Alps and all along their borders a few thunder-storms are enough to cause at once a great depression of temperature for days; and, in consequence of alterations of a somewhat general nature, a whole month may be materially changed. In Tibet, and as far north as Khótan, nothing of this kind could be traced in summer; also autumn remains very constant; only in spring the occasional fall of snow may cause some irregular modification of weather and temperature.[1]

The *sanitary conditions of Tíbet* had to be judged from the state of health of the natives, who appeared to suffer principally from the roughness, and from cold and wind at certain heights, but much less from the extreme dryness. Their heavy and comparatively indigestible food has a decided constipating effect upon the bowels.[2] Inflammation of an acute character is not unfrequent, but it rather affects the stomach and the bowels, occasionally the throat, not often the lungs. Chronic complaints of the lungs I could trace nowhere amongst the Tibetans, as little as intermittent fever; but it might be difficult to decide in which cases of pulmonary complaints already existing, the conditions of the country might be favourable, the change of pressure being so very great, though the temperature would be at least as good as that of St. Maurice and similar Swiss sanitary stations in summer. The effects of height we felt, together with our companions, up to heights of 22,000 feet, have been detailed already in the general hypsometrical tableau of the second volume, where we had to point out as a novelty the manner in which the stomach was affected thereby. This latter effect was, besides, materially increased when the wind blew; in balloon ascents this modification was never remarked, and indeed it had little chance of being felt, since, when the wind blows, the very progressive motion of the balloon must nearly counterbalance its effect upon the traveller.

In the British Association of 1863 Mr. Glaisher gave some account of the

[1] Moorcroft, Vol. I., p. 398, mentions a heavy snowfall having taken place at Leh as late as end of May, the snowy cover remaining from May 28th to June 2nd.

[2] Laxantia were the medecines we had most frequently to apply, and the first year our stores had but too soon disappeared. Our native doctor, Hárkishen, assured us that instances of absolute constipation of the bowels, lasting ten to twelve, or even fourteen days, were not unfrequent. In such cases the outward appearance of the patients denoted uneasiness bordering on melancholical despair, but there were no decided marks in complexion or habitus.

changes in colour that he and Mr. Coxwell experienced in ascending, and remarked that they could then go a mile higher without turning quite so blue as before.[1] Prof. Owen considered it the result of gradual adaptation in consequence of repeated ascents, notwithstanding the intervals between the different ascents: those on the plains did not make so large a use of their breathing apparatus as those who lived in great altitudes: hence more cells occupied by mucus would be taken up and opened to free intercourse and play. The ascent of a mountain being a change of pressure so much slower than that of the rising of a balloon may be the cause that we never had an opportunity of observing this change of colour.

The number of inhabitants in Tíbet is remarkably small, and a curious modification it is, remarked by every traveller, that the number of men is decidedly greater than that of women. I could not judge how far the wretched condition of most of the native habitations, combined with undue exposure to the injuries of climate, may have a share in reducing the population by increasing the mortality of children; at all events, with the present Tibetans even the number of births also is comparatively small.

As a further modification, complicating the difficult researches about the causes of cretinism and the frequency of goîtres, I must draw attention to the fact, that also in the highest habitations of Tíbet we found many cases of it; but they are still more frequent amongst the various tribes inhabiting the foot of the Himálaya. With Major Holmes, at Sigáuli, who liberally applied medical assistance by iodine ointments,[2] I saw groups of hundreds of these wretched creatures arriving from the wildest districts during the cool season. And nevertheless no region of the globe could differ more than Tíbet from the Himalayan tarái, in temperature, pressure, moisture, conditions of food and soil, not less than in reference to the ethnological types of their inhabitants.

The *climate to the north of the Karakorúm chain* was found to change rapidly when the crest had been passed. I was not less surprised by this when first descending its northern side than by the unexpected discovery that it was this chain —and not the Kuenlúen—which forms the watershed between Central Asia and India,

[1] Anthropological Review, I, 4, p. 414.

[2] In the hot season, and easily, too, if oidine ointment is applied without the necessary precaution, congestions, even ending in deformities of the heart, are caused.

the mightiest of our globe. To complete here the geographical definition as far as it may be of interest for the meteorological conditions, I must add that the Kuenlúen chain only branches off from the Karakorúm to the east of the Yárkand[1] road in an east-westerly direction, and that the crest of the Karakorúm runs here from north-west to south-east, nearly parallel to the Himálaya. As was to be expected, the modifications of moisture and local atmospheric currents show a decided connection with these topographical forms.

To the north the Kuenlúen is followed again by a region the greater part of which is a desert already at its very foot and still more completely so in the direction of Lake Lop.[2] But, nevertheless, along the northern borders of High Asia an increase of moisture is felt when we approach the limits of the mountainous region; and already in the plateau-shaped highlands separating the Kuenlúen from the chain of the Karakorúm the moisture sensibly increases towards the north.

As shown in the *View of the Kiúk Kiöl Salt-lake* (Plate 13), the sky has the dark but fresh tint of the Alpine regions of Europe, though the sand of the desert, covering and smoothing the rough slopes of the rocks, shows at the same time the neighbourhood of Central Asia; on many another day we remarked, in these regions too, the yellowish tint of the dry haze as we see it in the horizon of the *View of Leh* (Plate 9), and in a somewhat different form, in the broken brilliancy of the sky in the *View of the Tsomoríri Salt-lake* (Plate 27).

Also my panorama of *The Kuenlúen, from Sumgál, in the Karakásh Valley* (Plate 29), can be mentioned here in reference to meteorological details. In these broad flat valleys westerly winds carry up heavy clouds and fogs for days; we had rain and snow several times at the end of August; but a sky like the one before us, brilliant and nearly cloudless, is more frequent in summer. The mornings then are nearly of a dead calm, followed, from 4^h to 6^h P.M., by a fresh breeze descending from the *névé* regions into the valley.

When, a few days later, August 22nd 1856, we crossed into Khótan by the Élchi Daván, 17,379 feet, the weather had changed; we were overtaken by heavy fog

[1] The ordinary route of the caravans and travellers following the Yárkand river has no secondary chain to cross, as we had, in proceeding to the province of Khótan.

[2] For the climate of regions somewhat analogous in various points I may refer to the communications of Prof. KÄMTZ, "Ueber das Klima der südrussischen Steppen." Geogr. Ges. St. Petersburg, 5th. Oct. 1863.

soon after having passed the crest; sleet, rain, and finally a violent snowstorm, followed: and so the difficulty of the descent over a slope quite unknown to even our native companions was not a little increased. In the night from the 22nd to 23rd of Aug. the thermometer had sunk to 11·5° Fahr. Without tent, food, or fire, we had to pass the night; there were only four of our wretched horses in a condition to allow of our venturing to take them with us, and two of them we lost the same night from cold.[1]

On the northern slope of thé Kuenlúen the periodical descending current is no more felt; northerly and north-westerly winds predominate; the southerly winds of Central Ladák and Kănáur are perfectly unknown here. Light showers are frequent in this zone from 7,000 to 10,000 feet; but the total amount of precipitation seems not to exceed 12 to 15 inches. In winter, we were told, snow is variable and irregular in quantity not unlike that of our Alps, but always easily fordable up to heights of 6,000 feet. We did not see any sledges with the natives; occasionally some days of exceptional intense cold, with easterly gales, make them suffer very much.

Formation of ice on lakes and rivers.

For Tíbet, and the chains of the Karakorúm and Kuenlúen, the periodic formation of ice on lakes and rivers also deserved special inquiry; the snow-line, and its variation in the different seasons, shall be analysed in the general comparison for all High Asia.

The freezing of lakes is here met with for the first time to the north of the equator. The *lakes* are, according to the reports of the natives, regularly frozen every winter. This must surprise us, if we consider that many of them—amongst the larger ones the Tsomoríri—have a specific gravity approaching that of sea-water.[2]

For the purpose of studying the physical and geological details of these lakes—objects highly exceptional in every regard—I arranged my journey from Spiti up to Leh so as to leave the route of the traders, but to touch the principal lakes. For the present

[1] A preliminary account was given to government from Leh, dated Sept. 26th, 1856—the 8th of our "Reports;" it was reprinted in the Journal of the As. Soc. of Bengál. Descriptive details about topography and scenery will be found in Vol. IX. of the "Results." For the detail of the Itinerary see Vol. I., p. 26.

[2] A diagram showing the heights and geographical position of the principal lakes of western Tíbet, 14 in number, is given in plate VI. of the "Panoramic profiles."

it may suffice to point out the fact,[1] that their congelation is favoured by their not being deep; when soundings were made from a raft of poles and inflated goatskins, I found only now and then 120 to 140 feet. But, again, the freezing must be somewhat delayed by the circumstance that the water, even of those which were least saltish, had its maximum of density not as fresh water (at about 39° Fahr.), but a degree or two below 32° Fahr., and coinciding with the freezing point, the latter being lower when the water was more saltish.[2]

The ice-cover of the lakes can be passed all the winter, and frequently even late in spring. In one instance, in the basin of the Áksae Chin, in Turkistán, I saw, in August 1856, a flat level coat of ice some feet thick resting upon the ground; the edges had somewhat shrunk by melting, but at the time no water was found under the ice; what had been there before must have had an outlet under the ice, a fresh congelation not having taken place, as was shown by the ground. In years when warmer summers coincided with winters somewhat less cold, Mohámmad Amín, the Túrki headman of our caravan, "who knew all about the place" except its height, had seen it filled with water.

In the panorama of Aktágh we have also a view of the situation of this lacustrine basin; the level of the ice we found to be 1,142 feet below the Kissilkorúm pass, and 16,620 ft. above the level of the sea.[3]

The *rivers*, the very largest excepted, are frozen all the winter, even as low down as 8,000 feet. The smaller affluents, in their steep descent from the fields of snow, are stopped the first, but a good sunshine frequently follows the earliest formation of ice for weeks, and a reiterated change between water overflowing the ice and the formation of new glacial strata then produces here masses of ice in the forms of cascades of surprizing dimensions when compared to the modest size of the rivulet in summer; in sheltered places, even late in spring, lumps, not unlike a conglomerate of transparent stalactites,[4] are found.

[1] For detail of the analysis and experiments shall be given in Vol. V.

[2] I constructed for this purpose before my departure a little voluminometer (given later on the plate of the Atlas illustrating some of our instruments) which allowed of one's observing the alterations in temperature simultaneously with those of the volume.

[3] Latitude North 35° 52'; Long. East Green. 77° 51'; the outlines of the panorama are contained in Plate VII. of the Panoramic Profiles, Fig. 16.

[4] Where, as at great heights, such columns are occasionally found still in summer, they are of great fragility; when touched they fall to pieces, all ice exposed for some time to the changes of atmospheric temperature becoming decomposed into granular fragments. For details see "Phys. Geogr. of the Alps," Vol. I., Chap. 1.

The larger rivers, the Indus, Sâtlej, Shayók, carry down a quantity of drifting ice, but, from the velocity of their currents, the formation of a permanent cover remains limited to the upper part of their course.

When crossing high passes, where generally the last camp is put up as near as possible to the crest for the purpose of facilitating the final passage on the following morning, it is quite regularly observed that in heights above 16,500 feet the dripping of the rivulets descending from the neighbouring snow-fields is followed by dead silence as soon as, in the later part of the afternoon, the direct rays of the sun are intercepted by the neighbouring mountains; even in July and August care had to be taken at such places not to be too late in collecting the quantity of water necessary for the camp.

The *plates* thus far published in the Atlas from the regions to the north of the Himálaya can be arranged in the following groups according to the objects they show:—

Illustrations of topographical character. The capital of Ladák and its environs (Plate 9); the valley of Yárkand, to the north of the Karakorúm Pass (Plate 17); the chain of the Kuenlúen from the halting station Súmgal, at its southern foot (Plate 29).

Plates of the Salt-lakes, comprising already all the views I had occasion to take; they are: Tsomoríri, in Spíti (Plate 27); Tso Gam, in Ladák (Plate 4); Tsomagnalarí, in Pankóng (Plate 28); Tso Mitbál, in Pangkóng (Plate 4); Kiúk Kiòl, in Turkistan (Plate 13).

Névés above the Snow-line we see in Plate 9, from the environs of the Sásser Pass: Plate 10 represents the Mustágh Glacier and its snowfields.

Plate 12, the interior of Mángnang, and Plate 16, the Monastery at Hémis, are objects of architecture in connexion with Buddhist worship.

For some of the plates not yet executed in oil-colour print, the geographical details are found in outline in the "Panoramic Profiles" of the Atlas.

KÁNAM, monastery in Kănáur.

Latitude North.	Longitude East Green.	Height.
32°	$78^1/_2$ °	9,296 feet.

These observations, made by CSOMA DE KÖRÖS for two years, were first communicated in CUNNINGHAM'S "Ladák," p. 184 (without year). The years I found in CSOMA'S works to be 1827-28.

1827-28. Mean of the month.					
January	34	May	59·8	September	63·9
February	36	June	66·3	October	56·2
March	40·5	July	69·2	November	43·9
April	49·9	August	67·7	December	37·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
35·8	50·1	67·7	84·8	52·1

Spíti Valley, in Western Tíbet.

Latitude North.	Longitude East Green.	Height.
32° 10′	78°	13,000 feet.

1846. Cunningham, "Ladák," p. 182, gives mean values for the whole year, based upon observations made by himself and his brother. The following table contains the "means," the mode of their calculation is not detailed.

1846. Mean of the month.					
January	19·2	May	49·0	September	55·5
February	18·7	June	59·5	October	40·1
March	24·5	July	63·6	November	22·8
April	40·9	August	58·6	December	14·3

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
17·4	38·1	60·6	39·5	39·4

Leh, the capital of Ladák.

Latitude North.	Longitude East Green.	Height.
34° 8′·3	77° 14′·6 ⚑	11,532 feet.

1847, Sept. and Oct. Cunningham, "Ladák," p. 183.

1848-9. Capt. Henry Strachey, "Physical Geography of Western Tibet," 1854. The description of the climate of Leh, pp. 58 to 61, contains various precious data, especially for the cold season;[1] but no monthly means are completely put together.

1856, from May to September. The observations in the observatory we had put up were continued during our journey to Turkistán by our native doctor, Hărkíshen; in July, August, and September[2] the observations showing the hourly variation were made for the 24 hours. For the months May and June, before our arrival, the observations by our establishments in the environs of Leh (and at the same or nearly equal heights) had to be used for deducing the mean. For the

[1] See p. 520.

[2] Compare also Vol. II., pp. 56-60.

months November to April I calculated the respective values by analogy from the Kánam curve.

SCHLAGINTWEIT, "Beob.-Mscr.," Vol. 19.

A. Variation of temperature in the daily period.

1856.							
Hours.	July. (16 days)	August. (27 days)	September. (20 days)	Hours.	July. (16 days)	August. (27 days)	September. (20 days)
Midnight	62·8	61·5	55·0	Noon	75·9	73·0	61·0
1^h A.M.	61·2	61·3	54·3	1^h P.M.	76·5	73·4	69·8
2 „	60·3	60·9	52·9	2 „	79·3	74·3	62·6
3 „	59·0	59·9	51·6	3 „	77·4	74·3	64·0
4 „	57·9	58·3	50·9	4 „	76·6	73·0	62·8
5 „	56·3	57·4	50·5	5 „	73·2	71·2	61·5
6 „	56·8	57·7	49·1	6 „	70·2	69·3	58·1
7 „	59·5	60·1	51·3	7 „	68·2	69·1	58·8
8 „	63·1	63·1	52·9	8 „	65·7	64·6	57·4
9 „	67·1	67·3	55·2	9 „	64·9	64·4	56·8
10 „	69·4	68·2	57·2	10 „	63·9	60·3	56·1
11 „	72·1	70·0	59·2	11 „	63·3	61·9	55·9

B. Mean of the months.

1856. Mean of the month.							
January	20	April	44	July	66·4	October	40
February	26	May	50·1	August	65·2	November	34
March	36	June	56·2	September	56·0	December	21

Isolated months. 1847: Sept. 57; Oct. 39. Means: Sept. 56·5; Oct. 39·5.

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
22·3	43·4	62·6	43·3	42·9

From July 4th to 9th a temporary station was put up on the shore of the river Indus, about two miles from the town. The temperature differed very little (greater was the difference of moisture). The height of the shore of the river was but 10,732 feet, therefore 800 feet below the town of Leh; and already here descending currents along the river, as we find them more distinct still in Bálti, could be traced.

The mean of SR. and 4ʰ P.M. was: July, 4th to 9th, $= \begin{cases} 67\cdot8^\circ \text{ Fahr. on the river} \\ 62\cdot9^\circ \text{ Fahr. at Leh.} \end{cases}$

Eastern Environs of Ladák.

For the month of June 1856 my observations enable me to add the following approximated means for comparison with Leh.

	SR.	4ʰ P.M.	Mean.
Junction of the Língti and Tódi-ju in Spíti	63·6	77·3	70·4

Latitude North.	Longitude East Green.	Height.
32° 9′	78° 12′	11,316 feet.

	SR.	4ʰ P.M.	Mean.
Mud, in Spíti	42·0	65·3	53·6

Latitude North.	Longitude East Green.	Height.
33° 51′·6	78° 1′·3⚐	12,421 feet.

	SR.	4ʰ P.M.	Mean.
Tsomoriri Salt-lake, in Rúpchu	36·4	63·2	49·8

Latitude North.	Longitude East Green.	Height.
32° 45′·4	78° 16′·6	15,130 feet.

Skárdo, the capital of Bálti.

Latitude North.	Longitude East Green.	Height.
35° 20′·2	75° 44′·0⚐	7,255 feet.

1856. Compiled from the observations of Adolphe and his establishment in Skárdo and its environs. Means based as usual upon $\frac{\text{SR.} + 4}{2}$.

Schlagintweit, "Beob.-Mscr.," Vol. 19.

1856. Mean of the month.							
January .	32	April . . .	51	July . . .	69	October. .	52½
February .	39	May . . .	58	August . .	68	November	43
March . .	45	June . . .	66	September	59	December	33

Mean of the seasons and of the year.

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
35	51·3	67·6	51·5	51·3

Búshia, in Khótan, Turkistán.

Latitude North.	Longitude East Green.	Height.
36° 26′	78° 19′	9,310 feet.

Búshia was the first settlement we met with to the north of the watershed of the Karakorúm, situated on the northern slopes of the Kuenlúen, after 22 days' travelling through highland deserts. When we arrived we found the inhabitants, nomadic Turks, partly in tents, but some of the families had not even put up their tents; also loose stoneheaves and caves are used as shelters; barley and corn are the grain they cultivate.

Those cold descending afternoon winds experienced all along the southern side of the Kuenlúen[1] were no more felt here; in August the predominating current was northerly but very mild.

The grain was to be cut "in about a fortnight," viz. in the first week of September; this from analogy with the Alps of Europe—in latitude they differ about ten or twelve degrees only from the regions of Khótan and Yárkand—would allow one to estimate the mean temperature of the year and the seasons as being equal to that of about 5,500 feet in the Central Alps and to differ little from the following approximations:—

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
22	45	61	45	43

[1] Compare p. 526.

YÁRKAND, the capital of Turkistán.

Latitude North.	Longitude East Green.	Height.
38° 10′	74° 0′	4,200 feet.

An approximate value of the temperature for the northern basis of High Asia, for the depression of Yárkand separating the Kuenlúen from the Sayanchán, may be deduced by combinations of Leh and Skárdo for the *height*, and by an additional correction (I found it = — 2° Fahr.) for the difference of *latitude* from the map of isothermal lines referred to the level of the sea. The approximate means I obtained are the following:

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
38	54	69	56	54

PART IV.

THE ISOTHERMAL PROFILES OF HIGH ASIA;

DECREASE OF TEMPERATURE WITH HEIGHT;

AND

CONNEXION WITH PHYSICAL PHENOMENA.

THE CONSTRUCTION OF THE PROFILES.

Characteristics of the lower and the upper contour. Alpine and Indian profiles. Graphic representations on Plate IV of the Meteorological part of the Atlas.

The decrease of temperature with height cannot be so easily deduced from the different stations as might be expected, since they are not equally enough distributed over the various regions; graphic representations may be so contrived as to assist in obtaining results of general value; but the delineation of a profile uniting topographically the types of the three chains of High Asia—Himálaya, Karakorúm, and Kuenlúen—offered various difficulties. Though the direction of the profile could be easily chosen so as to show, sufficiently well, types of the principal crests and depressions, the meteorological modifications peculiar to the eastern parts, in consequence of the predominant moisture and southern position, then remained to be completed by explanatory details. Another difficulty was, that the horizontal and the vertical dimensions had to be represented on scales widely differing.

The general elevation of the mountains above the plains both in India and Turkistán, and the great difference in height between the peaks and valleys—all being so much greater than the respective dimensions of Alpine profiles—would have resulted in the production of a succession of needle-shaped points, with scarcely any characteristic individual features, had I followed here the same plan as formerly in my researches concerning the physical geography the Alps.

For the delineation now before me I found it best to proceed from left to right, in conformity with reading in general; the somewhat westerly position of the northern part must be noticed therefore as a deviation from the representation which might be expected from the ordinary succession on maps.

As to the vertical section, I found it best to keep *two separate profiles*, one representing the *lower slopes, valleys, and passes*, the other including the *predominant peaks*. Even in this form there is unavoidably a considerable exaggeration of the inclination; but, to a certain degree at least, by uniformity in the deviation from nature, a comparison of topographical character is not thereby completely excluded. Though certainly disfigured, the section still remains an outline of nature for the learned eye. The diagrams now given in a descriptive form, in reference to their leading features, are those contained in the fourth meteorological plate of the Atlas; they will allow of one's remarking unexpected differences between the different parts of High Asia.

In these figures *the lower one of the two profiles* shows the accumulation of solid matter raised up along the crests as a predominating feature; to our left, on the Indian side of the Himálaya, the first slopes facing the plains are, at the same time, those where the principal sanitaria are met with—most of which are included within the small variation of 6,000 to 7,500 feet. It so happens that the isothermal lines of the year—from reasons of a more general character than the topography of the Himálaya alone—remain nearly parallel to its mean direction; the consequence is, that, in reference to the mean temperature of the *Year* at least, stations in the outer Himálaya, of the same height but in parts at a very great distance from each other, differ remarkably little. We observe nearly the same in the *hot season* and in *Autumn;* and, whilst in the *cool season* it is the influence of latitude which shows itself more predominant, in the *rainy season* the difference of longitude becomes more powerful—a more westerly position creating a remarkable increase of heat together with a decrease of rain. A little prominence is next seen, representing the type of isolated peaks and ridges in the immediate environs of the outer stations.—The slopes leading up to the higher parts of the principal Himalayan crests are modified at their basis by the flats coinciding with the principal region of inhabited places in the interior: higher up they are followed by the terraces—frequent enough, though not forming a uniform band throughout—where the last pasture grounds are met with,

surrounded to the north by the walls of rocks and snow. On the northern (Tibetan) side of the Himalayan crests the flats of the highest pasture grounds are considerably more elevated, 15,200 feet being their average height; and, in analogy with the inclination of the slopes—this being in general more gentle in Tibet—we even see occasionally a well-marked plain of very little inclination in elevation between 18,500 to 19,000 feet in the glacial regions of the Spiti névés.

In profiles such as the one here described *Passes* are generally drawn so as to form the highest point; but I found it more characteristic to add to each side of the passes the profiles of their next environs. Thus, not only the feature of a pass as such becomes better defined, but also the modification of the environs becomes apparent at the same time; they vary equally with the country, and are also important for the practical use of the pass.

In Tibet, notwithstanding its various topographical modifications, the principal feature which must first show itself in a representation limited to an abstract, as the one before us, is that of a wide opening between the two principal chains. We see a broad valley with elevated basis and slopes gentle enough—only those declivities being steep which are the immediate effect of the *erosion of rivers;* and they are gigantic, too, for it is not unfrequent that the cutting of the rivers can be traced to a depth of 2,000 to 3,000 feet.[1]

The depth of the river-beds produces a local modification of drainage and humidity of the soil, but its participation in the gradual alteration of climate in its thermal elements is not less important.[2] Erosions exercise a considerable influence upon the circulation of the ascending currents, the accumulation of cold air in winter, and the evaporation—therefore a few words may be added here about them, though in anticipation of the geological considerations.

In the Alps, for instance, erosions of 500 to 600 feet are rather unusual. *In the Himálaya*, the mean depth is 1,200 feet at least, and many a place, where a limited resistance of the soil facilitated the action of the water, shows a cutting much deeper still. The lowering of the river-beds to such considerable depths has produced an-

[1] I have had occasion already to allude to the remarkable modifications by erosion in connection with the question of *permanent alteration of climate*, p. 135 of this volume.

[2] The deep barrancas of the Andes allow one to suppose a similar influence, though it has not the chance of being quite so powerful, since the Andes have nothing analogous to those surfaces of névé and glaciers so frequent in the Himálaya and in Tibet.

other phenomenon very characteristic for the topographical conditions of the Himálaya, and one not without influence upon its climate, viz. the complete drainage of nearly all its lakes. Lacustrine deposits, the regular alternation of level flats and steep ascents in the basis of many valleys, &c., prove the existence of lakes in numerous places; generally the river running through has so completely drained them, that now even the humidity of the soil in the lacustrine flats is no more unusually great. As we had nowhere found attention drawn to this fact by previous observers, we were the more careful as regards the interpretation till the number of such localities and the regularity of their lacustrine forms had decided the question.

As lakes still existing in the Himálaya, one near Naínital, and two in Kashmír, are the only ones[1] worth mentioning; the two latter are small and shallow fragments when compared to the surface distinctly marked by the traces around them in the lacustrine basins now drained by the Jhílum river.[2]

In Tíbet, too, by far the greater number of lacustrine basins are now empty; the few remaining are brackish—in consequence of their gradually drying up. This goes on still, its beginning may be considered to have coincided with the period when a certain number of the sheets of water around them had gradually disappeared by drainage.

Their height, at present, differs but little from about 15,000 feet: I say at present, since, when following the principal line of salt-lakes on my way to Ladák at much lower elevations I met with a great number of lacustrine basins well marked as such by their form and by the saltish smoothened soil, but now completely dried up; these were much more numerous than those still partially filled. The highest salt-lake I found was the Tso Gagár, in Ladák, nearly 12 miles south of the Indus, 15,693 ft. As topographically of greater importance, the Mansaráur and the Rákus Tal Lakes, about 15,250 feet in height, must be mentioned; they are situated but little below the flat high ground separating the eastern and western parts of the longitudinal Tíbetan valley and of the river systems diverging from here into the oceans to the east and west of India.

[1] The *lake* in Bhután upon which Turner, in October 1783, skated to the admiration of the Bhútias, is as to its size insignificant, rather a pond; later in winter the ice melted away again. Turner's "Bhután," p. 355. The large lakes, on the contrary, once frozen, keep their covers of ice till late in spring. See above, p. 527 of this volume.

[2] A Panorama of the Chunár lake is given on Plate 18 of the Atlas; it is so shallow that all over its surface "floating gardens"—rafts covered with earth for cultivation—are fixed in the ground by poles being pushed down between the trunks; compare p. 509.

The depth of the erosion in Tíbet is the more surprising if we compare it with the small quantity of atmospheric precipitation. But the circumstance that all its action chiefly coincides with the melting of the snow, increases its power, as does also the geological condition of the country: its rocks are less hard (being chiefly jurassic) than those in the Himálaya. And even an *apparent* increase of erosion can be the consequence of rain being not too great, and limited to the hibernal period: the *decomposition* of the forms originally produced by erosion must be much less rapid than in those regions where rain is excessive throughout. In Síkkim we positively see a fact of the opposite nature; there the decay of the lateral slopes is already so remarkably modified by the power of the heavy rains, that it is not easy to recognise the upper limit of erosion without entering into a critical analysis of the forms as well as of the deposits.

One peculiarity more must be mentioned here to complete the orographic characteristics: the non-existence of cascades. This too is a consequence of the great erosion and is not chiefly modified by the quantity of atmospheric precipitation—where could this differ more, within distances so small, than in the Himálaya and Tíbet?—but by the extent of the river systems. Traces of cascades are wanting as little when looked for as those of the lakes.[1]

Plateaux are not met with at all in the Himálaya, and although they do occur in Tíbet, as detailed already in our hypsometrical tableau,[2] they are neither large nor numerous: flat open valleys with an elevated basis and ridges of no very great elevation along their sides are no plateaux; this is the more to be kept in mind in the analysis of the physical geography, as the configuration of the surface is an element so important here too.

The farther we follow the Dihóng and its tributaries to the east, or the Sátlej and Indus to the west, the oftener do we meet with places of minor elevation, such as Lhássa or Skárdo; in the section of my profile I did not descend beyond the height of the Indus near Leh, as this fairly can be considered as characteristic for the average height of a great number of inhabited places, the highest of them, the

[1] Compare p. 136, note. Only on the northern side of the Kuenlúen, during one descent into the plains of Turkistán, we saw the first fine waterfalls, where the slope of the chain is short and steep. Little sheets of water like a "cascade" near Darjíling, or one I met below Nărigún (drawing Or. No. 383), are scarcely worth mentioning.

[2] "Results," Vol. II., p. 486.

Buddhist monastery Hánle, even going up to 15,117 feet; Skárdo, the only place in Tíbet below 10,000 feet for which I had meteorological data allowing to deduce monthly means, had to be marked therefore *within* the section, not in a contour-shaped part of the profile, as I equally had to do it with the stations in the interior of the Himálaya. If not placed in this form a narrow cut disfiguring the principal features would have had to lead down to every one of my stations which did not happen to coincide with the outer contour of the section. The highest pasture grounds are met with above 16,000 feet (*e. gr.* Lársa, 16,349 feet, near the Tákelang Pass): in reference to their topographical character they differ less by reduced inclination from the parts above or below them than is the case in the Himálaya.

The passes, even those leading over the principal crest, over the Karakorúm chain, are wide openings; their slopes are remarkably flat, and more so still to the north than to the south. The peaks surrounding them differ but little in height from the crest in general; the Sásser peak, alluded to here by the needle to the left of the pass, where we found the height by the barometer to be 20,120 feet, whilst the pass close by was 2,370 feet lower, is an instance rather exceptional than frequent.

The part following next, the space between the Karakorúm and the Kuenlúen, is occupied by vast plateaux of great uniformity of height; they would appear more distinctly still as such in my section were not the difference between the horizontal and vertical scales so great.

In the *upper one of the two profiles*, in the representation of the peaks, I found it more difficult still to unite them in distance proportionate to the length of the basis and to give to the various peaks the respective height without completely losing the individual forms; I therefore limited myself exclusively to taking up the outlines of the very highest crest and to giving in every group only some of the most characteristic peaks, a selection which could not ever be made throughout according to height alone since peaks of first rank so frequently are surrounded by neighbours nearly equally high but no more so important as those at some distance, where height again begins to increase and local maxima are found reappearing. The two predominant groups of Peaks also coincide with the two principal crests, Himálaya and Karakorúm.

In the seven Plates of Panoramic Profiles of the Atlas most of the prominent peaks may be found united.[1] Although not unfrequently small enough, in consequence

[1] The "Views" contain many aspects more detailed.

of their distance from the point from which the panoramas were drawn, they would occupy a length of some 15 feet when arranged along one general section from India to Turkistán; in the thermal profile here before us within the distance of a few inches some of their features had to be sketched.

In the third chain, the Kuenlúen, all my data are limited to what we could see and measure from our own routes. The information we gathered from natives was vague enough, as usual; but at least it sufficiently corroborated our own impressions as to the individual character of the peaks. They do not increase in height in the same proportion as we see the principal crest rising up, and the slope descending to the north from this group of peaks is considerably flatter than the Himalayan descent on the opposite side, facing India. As to the Kuenlúen itself, its southern side is less steep than that toward Turkistán.

A section of the Alps with isothermal lines is added for comparison.

For the *profile of the Alps*[1] I had not felt the necessity of reducing so much "*in proportion*" the scale of horizontal extent as I was now obliged to do it in the section of High Asia; in the Alpine profile, therefore, peaks, valleys, and slopes could be united by one general outline; I kept this form in the reduction added to the present plate, the more as it is at the same time an example of a different method of delineation.

In length the Alpine profile should have only $^2/_5$ of its present dimensions on the same scale as it actually is in height, with the profiles of High Asia for the seasons (on the plate to the left and right of the profile for the year).

To facilitate a comparison with the profiles of High Asia I have *inverted* the position of north and south in comparison to the original in my "Researches" in the Alps; the lines I did not reconstruct for degrees of Fahrenheit in round numbers; but I reduced them only in size; this allows one, at the same time to determine at once the values according to Centigrade or Réaumur, the scales which we find quoted nearly exclusively in Alpine literature. At 50 degrees, besides, we see passing the lowest line of the isothermal profile of the Alps, whilst that of High Asia is still intersected by the line of 73° Fahr. This, too, as well as the dimensions, must be alluded to here to complete the comparison; from Avignon to Vienna, for instance, the difference in longitude is $11^1/_2$°, the breadth of the Alps showing a difference of only 4° in latitude; whilst for High Asia the longitude differs from east to west 25°, the latitude more

[1] "Physical Geography of the Alps," Vol. I., Plate VII.

than 10°. The surface overtowered by the Himálaya, Karakorúm, and Kuenlúen is fully more than 10 times that covered by the Alps.

The *profiles from various parts of India*, including the Nílgiris, given in Plate III. of the meteorological part of the Atlas, are drawn so, in analogy with that of the Alps, that only one contour line is used. What I give there is all I could put together in a graphic form from the tropics next to the equator. For the mountainous regions of Africa, even of tropical America, positive data are not numerous enough to allow a representation of isothermal profiles. In my profiles from India another modification was introduced: a dotted line is drawn. The dotted line shows the the contour which the topographical section ought to have for the actual temperature of the *season*, supposing the value of the decrease to have remained the same throughout the year.[2]

To the outlines of High Asia an analogous combination could not well be added; the local conditions being so much more varied in height and distance, and what is more important still, the deviations, as we shall see, being so much greater in the central parts, that all approximate uniformity in type—an important condition for easy comparison—would necessarily disappear.

For High Asia five profiles are given in Plate IV. of the Atlas; that for the *mean of the year*, on a larger scale, also contains such hypsometrical data as are in immediate connexion with the combination of various meteorological elements—not with temperature alone—such as the limits of inhabited places, pasture grounds, vegetation, snow-line, and glaciers.

The snow-line had also to be reproduced separately in each of the four profiles of the seasons. In the scale here used its level in summer does not differ much from its absolute maximum (shown by the dotted line in the profile of the annual means); but when we come to compare more closely the lines, as well as the numerical data, we still see some deviations appreciable enough.

The passes across the principal chains (of which few only could be shown here) have the following *mean* heights: in the Himálaya 17,800 feet, in the Karakorúm 18,700 feet, in the Kuenlúen 17,000 feet.

[1] "Physical Geography of the Alps," Vol. I., Plate VII.

[2] For details I refer to p. 140. Here it may be sufficient to repeat, that a place too warm in a season when compared with the mean of the year is placed now below the real contour, and *vice versâ*.

The depressions surrounding and separating the different parts of the profile are the following:

Indian plain, along the southern border of the Himálaya, 660 feet high.

Valley of the Indus, in Western Tíbet, the principal separation between the chains of the Himálaya and Karakorúm; height near Leh 10,723 feet.

Karakásh valley, a wide depression separating the chains of the Karakorúm and the Kuenlúen; height near the Nephrit (Yáshem) quarries of Gulbagashén 12,252 feet. This is not far above the bend of the river where it breaks through the chain of the Kuenlúen.

Plain of Turkistán, near Yárkand about 4,200 feet.

THE ISOTHERMAL TABLES.

Materials. Tables for the year and the seasons.

The calculation of the isothermal tables is based upon the means of the stations given above and upon a great number of isolated observations made during our travels, also beyond the limit of permanent habitation, and at elevations so considerable that they are approximatively comparable to the temperature in the free atmosphere.[1]

Amongst the results which I obtained from a chaotic mass of calculations, the following may be mentioned as the principal features:—

The rate of decrease varies little as long as the same local forms prevail, but it becomes at once more rapid when we approach the heights where a somewhat sudden decrease of solid mass takes place, viz. where the ridges and peaks begin to predominate.[2] In the Alps this may be roughly estimated to be the case at about 6,000 to 7,000 feet in height; in the Himálaya it is at about 17,000; in both regions it coincides, not quite accidentally, with the limit of trees.[3] In Tíbet the

[1] In order better to define the decrease also at places for which I had but a limited number of observations, such reductions were made as I have alluded to p. 112, Note 1. In referring these values to periods of longer duration care has chiefly to be taken that two stations thus compared are not very distant, and—what is not less important—that they belong to the same type of climate.

[2] What I allude to here may best be illustrated by the following analogous consideration. Suppose we had a plastic model of the country cut through horizontally into sections of equal height or thickness; the succession of those two sections which show the greatest difference coincides with the region where the decrease of solid mass is most rapid.

[3] This participation of a topographical element also explains why the limit of trees does not so completely coincide with the same isothermal line throughout, even if we compare regions not very distant.

region of a rather sudden decrease of solid mass is considerably higher, and varies, with the general elevation of the country, between 14,000 to 15,000 feet.

A peak, or the ridge of a pass, compared with a valley, has the chance of showing a decrease of temperature greater in summer and smaller in winter than the comparison of two objects whose forms are of the same nature.

The more a peak is isolated the more it will approach the temperature of the free air;[1] and such objects alone, if exclusively compared, can allow of our drawing some conclusion in reference to the free air.

The tables here following show the position resulting for the lines for every 5 degrees Fahr., and the elevation corresponding to the decrease of 1° Fahr. is added in the margin.

The "mean coëfficient of decrease of temperature with height" is the arithmetical mean of *all* those marginal numbers, viz. of all the elevations corresponding to a decrease of 1° Fahr. (It is not simply deduced from the difference between the highest and lowest temperature, being divided by the relative height of the peaks or crests). By introducing the single values I obtained at the same time a result in conformity with the relief of the mountain systems, viz. with the height actually existing.[2]

[1] Also the balloon ascents showed great irregularities in the decrease of temperature in the free air. In Europe, above England, Glaisher had obtained, as detailed in the British Association, 1863, on an average a decrease of 1° Fahr. for 300 feet at about 4,000 feet, the change being considerably more rapid below this stratum and less rapid above it.

[2] This mode of calculating also presented means for testing the values independently obtained in the seasons: the mean of the sum-total of the differences in the four seasons had to agree, as it actually did, with that deduced from the isothermal lines of the year.

Isothermal tables.

A. Mean of the year.

Temp. Fahr.	Himalayan borders facing India.		Interior of the Himálaya, southern slopes.		Western Tíbet, northern slopes of the Himálaya, Karakorúm.		Kuenlúen; both slopes of the crest, and borders facing Central Asia.		Temp. Fahr.
	Height.	Diff.	Height.	Diff.	Height.	Diff.	Height.	Diff.	
75½	0	...	.....	...	.....	...	.....	...	75½
70	2,200	400	0	...	.....	...	.....	...	70
65	4,200	400	1,950	390	.....	...	.....	...	65
60	6,200	400	3,950	400	.....	...	.....	...	60
55	8,200	400	6,000	410	7,000	...	3,400	...	55
50	10,100	400	8,050	410	9,000	400	5,100	340	50
45	10,900	360	10,100	410	11,000	400	6,800	340	45
40	13,700	360	12,150	410	13,000	400	8,500	340	40
35	15,500	360	14,200	410	15,000	400	10,550	410	35
30	17,300	360	16,250	410	17,000	400	12,600	410	30
25	19,100	360	18,300	410	18,900	380	14,650	410	25
20	.....	...	20,350	410	20,800	380	16,600	390	20
15	.....	...	22,400	400	22,650	370	18,550	390	15
10	.....	...	24,400	400	24,500	370	.....	...	10
5	.....	...	26,400	400	26,300	360	.....	...	5
0	.....	...	28,400	400	28,100	360	.....	...	0

General mean coëfficient of decrease of temperature for the year = 390 feet for 1° Fahr.

In reference to means for the different parts, I obtained:—

For the Himálaya and Tíbet 385 to 400 feet for 1° Fahr., values alternating *within* the groups being modified by the topographical conditions; for the Kuenlúen 380 feet is the height corresponding to the decrease of 1° Fahr.[1]

In the Himalayan borders facing India, where the increase of temperature, on account of the vicinity of the Indian plain, is felt most distinctly, the lower parts have a slow decrease, but above heights of 10,000 feet it becomes more rapid than the general mean.

[1] For the Alps I had obtained 320 feet for 1° Fahr. (=540 French feet for 1° Cent.). "Phys. Geogr. of the Aps," pp. 334-370. A comparison of the results for various other mountain systems is also given in the same work, p. 347.

In Tíbet the relative accumulation of heat up to 17,000 feet is followed, in the regions still higher, by a gradual conformity with the environs in general; the decrease with height becoming now somewhat more rapid than it is at an equal height in the interior of the Himálaya, southern slopes.—The borders of the Kuenlúen facing Central Asia, and the plains of Turkistán from Yárkand to Lake Lop, are nearly as warm in summer as the Indian side of the Himalayan crest (at equal heights); this increase is somewhat felt still in the mean of the year for heights up to 3,000 and 4,000 feet.

As to the annual variation at different heights, the numerical tables of the stations can be compared up to 11,000 feet. With respect to variation and absolute extremes at greater heights, even those of the Alps cannot be determined with certainty; we obtained only recently some isolated data. However, for High Asia, too, we may be guided by them in forming some approximate ideas, considering that the annual mean calculated for Mont Blanc gave — 5° Fahr.,[1] while for Gaurisánkar and Dápsang it is 0° Fahr. On Mont Blanc Col. Robertson had put up, July 16th 1860, several instruments; one Casella minimum (No. 314) was found in good order by Mr. Blandford six weeks later; August 30th it stood at — 17° Fahr.

As maxima for the highest Alpine peaks temperatures of 50° Fahr. may be named, such as shown by the observations of Zumstein on one of the Monte Rosa peaks. The coldest temperature known to me for St. Bernhard is — 22° Fahr.[2]

[1] Schlagintweit, "Phys. Geogr. of the Alps," Vol. I., pp. 372-374.

[2] Ibid., p. 371.

B. Seasons.

1. Winter: December, January, February.

Temp. Fahr.	Himalayan borders, facing India.		Interior of the Himálaya, southern slopes.		Western Tíbet, northern slopes of the Himálaya, Karakorúm.		Kuenlúen, both slopes of the crest, and borders facing Central Asia.		Temp. Fahr.
	Height.	Diff.	Height.	Diff.	Height.	Diff.	Height.	Diff.	
65	0	...	.....	...	.....	...	.....	...	65
60	2,000	400	.....	...	.....	...	.....	...	60
55	4,000	400	0	...	.....	...	.....	...	55
50	6,100	320	2,100	420	.....	...	.....	...	50
45	8,200	420	4,200	420	.....	...	.....	...	45
40	10,100	380	6,400	440	.....	...	3,600	...	40
35	11,800	340	8,500	420	7,200	...	5,400	360	35
30	13,400	320	10,600	420	9,100	380	7,200	360	30
25	15,000	320	12,700	420	11,000	380	9,100	380	25
20	16,500	300	14,800	420	13,100	420	11,000	380	20
15	18,000	300	16,800	400	15,200	420	13,000	400	15
10	19,500	300	18,700	360	17,300	420	15,000	400	10
5	.....	...	20,500	360	19,400	420	17,000	400	5
0	.....	...	22,300	360	21,400	400	19,000	400	0
5	.....	...	24,000	340	23,300	480	.....	...	5
10	.....	...	25,500	300	25,100	360	.....	...	10
15	.....	...	27,000	300	26,600	300	.....	...	15
20	.....	...	28,500	300	28,100	300	.....	...	20

Mean coëfficient of decrease of temperature = 380 feet for 1° Fahr.

The heating influence of the tropical plains reaches—but does not pass beyond—the Himalayan crest. In Turkistán, *vice versâ*, the cooling influence of the general depression of temperature in Central Asia becomes apparent.

2. Spring: March, April, May.

Temp. Fahr.	Himalayan borders, facing India.		Interior of the Himálaya, southern slopes.		Western Tíbet, northern slopes of the Himálaya, Karakorúm.		Kuenlúen; both slopes of the crest, and borders facing Central Asia.		Temp. Fahr.
	Height.	Diff.	Height.	Diff.	Height.	Diff.	Height.	Diff.	
78	0	...	.....	...	.....	...	.....	...	78
75	2,000	400	0	...	.....	...	.....	...	75
70	4,000	400	1,800	360	.....	...	.....	...	70
65	5,750	350	3,600	360	.....	...	.....	...	65
60	7,400	330	5,400	360	.....	...	3,200	...	60
55	9,000	320	7,200	360	7,000	...	5,200	400	55
50	10,550	210	9,000	360	8,900	380	7,200	400	50
45	12,100	310	10,800	360	10,750	370	9,200	400	45
40	13,650	310	12,600	360	12,600	370	11,200	400	40
35	15,200	310	14,400	360	14,300	340	13,200	400	35
30	16,750	310	16,200	360	15,900	320	15,200	400	30
25	18,300	310	18,000	360	17,500	320	17,150	390	25
20	.....	...	19,700	340	19,200	340	19,100	390	20
15	.....	...	21,400	340	20,900	340	.....	...	15
10	.....	...	23,100	340	22,600	340	.....	...	10
5	.....	...	24,800	340	24,300	340	.....	...	5
0	.....	...	26,500	340	26,000	340	.....	...	0
5	.....	...	28,200	340	27,700	340	.....	...	5

Mean coëfficient of decrease of temperature = 360 feet for 1° Fahr.

This period being the hot dry season of the Indian plains, the temperature also rapidly increases in the Himalayan borders next to India; for the Himálaya in general the change is very gradual in temperature and moisture; heavy rains are not unfrequent in May. In Tíbet the greater increase of temperature takes place near the end of this season. March and April are still cold and very rough at many of the inhabited places.

Within the various groups we find stations situated in valleys remarkably cooled in consequence of the accumulation of air brought down by descending currents. The same we observe in the plains of Turkistán to the north of the Kuenlúen.

3. Summer: June, July, August.

Temp. Fahr.	Himalayan borders, facing India.		Interior of the Himálaya, southern slopes.		Western Tíbet, northern slopes of the Himálaya, Karakorúm.		Kuenlúen, both slopes of the crest, and borders facing Central Asia.		Temp. Fahr.
	Height.	Diff.	Height.	Diff.	Height.	Diff.	Height.	Diff.	
86	0	...	.....	...	.....	...	.....	...	86
85	500	500	0	...	.....	...	.....	...	85
80	2,500	400	1,000	360	.....	...	.....	...	80
75	4,500	400	3,600	360	.....	...	.....	...	75
70	6,250	350	5,500	380	6,250	...	5,000	...	70
65	7,850	320	7,500	400	9,600	670	7,250	450	65
60	9,600	350	9,600	420	13,000	680	9,500	450	60
55	11,600	400	11,850	450	15,500	500	11,650	430	55
50	13,850	450	14,100	450	17,500	400	13,700	410	50
45	16,100	450	16,350	450	19,250	350	15,700	400	45
40	18,350	450	18,600	450	20,900	330	17,700	400	40
35	.....	...	20,850	450	22,500	320	19,700	400	35
30	.....	...	23,100	450	24,100	320	.....	...	30
25	.....	...	25,350	450	25,700	320	.....	...	25
20	.....	...	27,600	450	27,300	320	.....	...	20

Mean coëfficient of decrease of the temperature = 420 feet for 1° Fahr.

The height of the rains in the Himálaya limits the increase of heat otherwise corresponding to the season, whilst for the same period in Tíbet an unexpected accumulation of heat is observed; it is partly the consequence of an unclouded state of the sky, but that it is felt in heights so very great is not less the effect of the general elevation of the soil.

All the higher regions of the atmosphere, thoroughly heated by the long duration of the currents ascending from the Indian plains, as well as by those rising now from the Tibetan highlands, show a comparatively warm temperature as far as to the north of the Kuenlúen.

A local diminution of heat is observed where the amount of rain is unusually great, such as at Darjíling, Naintál. The Tibetan highlands, especially at heights like the environs of Leh, not exceeding 12,000 feet, show an unusual local increase of heat; an *apparently* rapid cooling must be the consequence when we compare them with the higher

regions, less differing from the general conditions of the atmosphere above High Asia. An analogous modification is observed wherever a *local* accumulation of heat takes place.

In India this season is nearly everywhere the rainy season, and the most rapid decrease of heat in the annual period coincides with it.

4. Autumn: September, October, November.

Temp. Fahr.	Himalayan borders, facing India.		Interior of the Himálaya, southern slopes.		Western Tíbet, northern slopes of the Himálaya, Karakorúm.		Kuenlúen, both slopes of the crest, and borders facing Central Asia.		Temp. Fahr.
	Height.	Diff.	Height.	Diff.	Height.	Diff.	Height.	Diff.	
77	0	...	.....	...	.....	...	.....	...	77
75	1,000	500	.....	...	.....	...	.....	...	75
70	3,000	400	0	...	.....	...	.....	...	70
65	4,800	360	2,000	400	.....	...	.....	...	65
60	6,600	360	4,000	400	.....	...	.....	...	60
55	8,400	360	6,000	400	.....	...	4,600	...	55
50	10,200	360	8,000	400	8,500	...	7,100	500	50
45	11,900	340	10,000	400	11,500	600	9,350	450	45
40	13,400	300	12,000	400	13,500	400	11,350	400	40
35	14,900	300	14,000	400	15,250	350	13,100	350	35
30	16,400	300	15,900	380	17,000	350	14,850	350	30
25	18,000	320	17,800	380	18,500	300	16,600	350	25
20	.....	...	19,800	400	20,000	300	18,350	350	20
15	.....	...	21,800	400	21,750	350	.....	...	15
10	.....	...	23,800	400	23,500	350	.....	...	10
5	.....	...	25,800	400	25,500	400	.....	...	5
0	.....	...	27,800	400	27,500	400	.....	...	0

Mean coëfficient of decrease of temperature = 390 feet for 1° Fahr.

In Autumn, too, the central parts are still comparatively "too warm;" the same we may say of the very highest regions when compared with those down to which the snow begins to descend at this season. Although with the snow-fall itself an appreciable disengaging of heat is locally observed, it is followed very soon, for the regions a little below, by a depression of temperature in consequence of the descending currents of cold air.

THE PRINCIPAL STATIONS COMPARED; RELATION TO THERMAL ANOMALY.

Selection *A:*	4,100 to 4,350 feet.		Selection *C:*	7,170 to 7,250 feet	
„ *B:*	5,150 to 5,650	„	„ *D:*	9,300 to 11,500	„

The preceding tables and their profiles refer to the *mean* of all the regions to the right and left of the section drawn across High Asia; an immediate comparison of various *stations* will allow us to judge of places little differing in height and latitude but considerably distant in longitude; thus, whilst the isothermal tables show the variation of height at *equal temperature*, we may here analyse the temperatures occurring at *heights nearly equal*—the practical point of view for judging the more easily of the stations as to their local and provincial conditions.

I limit myself to forming four such selections, including the larger places and beginning in the east.

Comparison of stations little differing in height.

Stations.	Height.	*Winter:* December to February.	*Spring:* March to May.	*Summer:* June to August.	*Autumn:* September to November.	Year.
Kathmándu. . .	4,354	48·4	61·9	72·8	63·7	61·7
Havelbágh . . .	4,114	50·8	66·6	77·6	68·0	65·8
Lohughát. . . .	5,649	45·6	59·7	70·9	61·2	59·4
Almóra	5,546	51·8	65·0	73·7	66·2	64·2
Srinágur	5,146	42·3	55·3	71·3	58·0	56·8
Darjíling	7,168	43·5	54·5	62·4	57·0	54·5
Símla	7,057	47·0	59·1	66·8	58·4	57·8
Márri	6,963	41·8	56·5	68·2	59·2	56·4
Skárdo	7,255	34·7	51·3	67·6	51·5	51·5
Kárdong	10,242	29·0	46·6	59·0	43·0	44·4
Kánam	9,296	35·8	50·1	67·7	54·8	52·1
Leh	11,532	22·3	43·4	62·6	43·3	42·9
Mean of Kánam and Leh . .	10,400	20·0	46·7	65·1	49·0	47·5

The stations of the average height of 7,000 feet shall be chosen to begin with, their topographical condition—a position on the top of a ridge—being the same for three of them.

In the mean of the year the eastern Himálaya is a little cooler than the western, even as far up the north-west as Márri, in consequence of the greater amount of moisture; the stations range: Símla > Márri > Darjíling. In the cool season the influence of latitude makes Márri[1] already the coolest of the three; but Darjíling, though 4° Fahr. farther to the south, is still cooler than Símla. In the hot season the influence of latitude becomes completely inverted, Márri being the warmest of the three.

What I said about the difference between the three stations at 7000 feet nearly coincides for all the seasons with the changes of the form of the isothermal lines referred

[1] Kässáuli, see p. 505, is a little colder still than Márri in winter, though it is situated close to Símla, probably in consequence of being locally more exposed to the winds predominating at this season.

to the sea-level, as in Plate III. of the Atlas; or, which is the same, if we take the *mean* of the height and the temperature of the three stations and deduce from these the rate of decrease from a comparison with the dotted lines of the maps—which I may call, for abbreviation, the fundamental lines—the resulting decrease must be expected to *vary very little.*

The mean height of the three stations becomes 7,063 feet, the temperatures are:

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
44·0	56·7	65·8	58·2	56·2

From the "fundamental lines" we obtain at sea-level for the basis of the Himálaya:

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
61	74	85½	76	74½

In consequence the elevation corresponding to the decrease of 1° Fahr. becomes:

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
415 feet.	410 feet.	370 feet.	400 feet.	400 feet.

Viz., the rainy season only, including our summer, and a part of autumn, show a rapid sinking of temperature with height.[1]

Havelbágh, though considerably differing in height from the stations Darjíling, Símla, Márri, gives a rate of decrease when compared with the "fundamental numbers" not materially differing from the numbers just obtained; but Almóra has a decrease much less rapid, 550 feet for the year. Kathmándu, Lohughát, affected by descending currents, are a great deal cooler; the decrease being 330 feet in the mean for Lohughát. It is nearly the same for Kashmír; the "fundamental line" passing under Srinâger

[1] When looking back to the tables we shall find these numbers agree very well with the mean of the "differences" in the first column as high up as 7000 to 8000 feet; but it evidently cannot be expected that they should coincide with the value of the mean coëfficient of decrease, which refers to much greater variety of height and extent.

shows a temperature of 72° Fahr., from which the decrease up to the valley of the Jhílum is 1° Fahr. for 340 feet in the mean of the year.

As to the seasons, we see for the valleys of Kathmándu as well as Srinåger, though much differing in extent, height, and position within the Himalayan chain, that spring has a most rapid decrease; it is nearly, comparatively, coolest, this coinciding with the greatest melting of snow, which produces a sensible increase of descending currents of cooled air. In summer the decrease becomes reduced again, partly by the accumulation of heat in consequence of the enclosed position. This is the more characteristic, if we keep in mind that the Indian stations, even heights like Dodabétta and Utakamánd included, decidedly show a most rapid decrease in the rainy season, in which partake the marginal stations freely exposed on ridges—Darjíling, Símla, and Mårri.

For the highlands of Tíbet we can compare but the western regions: Lhássa is still unexplored, for meteorology not less than for many a question of Buddhism. As the mean from Leh and Kánam—excluding as much as possible local irregularities—we obtain the following temperatures:

Height.	Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
10,400 feet.	29·0	46·7	65·1	50·4	47·5

By introducing these values into the formula $d = \frac{h}{t_n - t'_n}$, where h is = 10,400 ft., and where t_n, the "fundamental number" at sea-level, becomes for

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
58	74	$86\frac{1}{3}$	$75\frac{1}{2}$	74

the values are for d, the height for the decrease of 1° Fahr.:

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
360 feet.	380 feet.	490 feet.	415 feet.	410 feet.

The mean for the year, when compared with the decrease obtained from the three Himalayan Sanitaria, differs less than might have been expected; but evidently it depends upon different causes, as we see from the distribution within the seasons.

In the Tibetan stations the decrease is by far the smallest in summer, when the great amount of surface exposed to a nearly tropical sun becomes a generator of heat of unexpected power.[1]

Large valleys in their lower parts are comparatively too cold in Tíbet too. For Skárdo, for instance, a decrease of one degree results for a difference in height of but 337 feet.

For the higher regions Kárdong also, in the Himálaya, likewise situated in a high valley but of smaller dimensions, is especially valuable. The fundamental numbers are the same as those for the mean of Leh and Kánam, and we obtain a depression of 1° Fahr. for

Dec. to Febr.	March to May.	June to Aug.	Sept. to Nov.	Year.
360 feet	380 feet	380 feet	340 feet	365 feet

viz., a fair mean between the type of Himálayan valleys and central Tibetan highlands.

In reference to the result of *local thermal anomaly*, we can define it therefore for the stations of High Asia as showing at equal height in the east a region too cold in consequence of excessive moisture, in the central and western parts a province too warm in consequence of the extensive elevation all around.

Thermal anomaly in general is the difference between the mean temperature of a station (corrected for elevation) and the mean temperature of its latitude; in this sense, when compared with the conditions of the globe all round the northern hemisphere, High Asia is too cold, or shows a *negative anomaly* only from November to February: in March it has become too warm already, but the *positive anomaly* just reaches Turkistán; from April to October High Asia is situated in the region too warm throughout.

[1] The thermal anomaly of India see above, p. 450 of this volume.

TYPE OF THE ISOTHERMAL LINES IN THE PROFILES OF HIGH ASIA.

The numerical elements and the decrease of temperature being detailed, the analysis of the form of the lines in the Plate of profiles will best make apparent what is peculiar to High Asia when compared with other mountain systems, and what may be considered a law of a more general character.

I. Heating influence of India.

The first modification presenting itself in the isothermal profiles, and alluded to already, is, that the southern slopes of the Himalayan borders facing India are too warm throughout the year in consequence of ascending currents of heated air.

The annual isothermal lines of 74·5°, 74°, and 73° Fahr., which, in the map of Plate IV. present themselves as running on the sea-level under the greatest part of the outer ranges of the Himálaya, are objects of reference the more decisive as they are but the junction of the stations to the west and east of the Himálaya in the Pănjáb and Assám,[1] and unaffected therefore by the influence of descending currents, somewhat modifying, as we shall see in Hindostán and Bengál.

In the isothermal lines of the profiles the gradual change in the steepness of these curvatures with the elevation is proportional to the diminishing of the influence of the

[1] Unless I obtained these fundamental dotted lines the comparison of different stations for deducing the decrease would have been very insufficient, since it would have remained arbitrary how to correct the effect of latitude. Even Pátna combined with Kathmándu, or Rámpur Bóleah with Darjíling, as easily seen from the map of the isothermal lines, would give a decrease much too rapid, Pátna and Rámpur being 77·8° Fahr. in the mean of the year, and the basis below Kathmándu and Darjíling only 75° to 74·6° Fahr.

plains in a *vertical* direction; in reference to its action towards the *interior* 100 to 120 miles may be considered the limit.

The cause of the heated air being pushed on so far, in a line nearly horizontal, instead of rising up as ascending current in a rather vertical direction, is partly the consequence of the otherwise predominating direction of the wind, and is partly caused by the equilibrium being maintained by descending currents in the valleys.

Such warm winds directed towards the interior must move on over Tíbet at a very great elevation; or rather we may consider it more probable that there they have lost already their moving power. Even at heights of 18,000 and 20,000 feet our observations, carefully directed to any such modification, did not show corresponding alterations in the direction of the winds. The Alps are analogous to the Himálaya in this regard, that they frequently cause the southern currents of warmer temperature to become lost in the higher regions of the atmosphere before they are felt along the surface in the northern regions. However, the breadth of the Alps being so much smaller, the effect is not so constant as that produced by the Himálaya.

Along the Alpine borders a heating effect of the Italian plain is observed, but it is not so powerful as that of India upon the Himálaya; the Alpine profile shows the analogous bending in the mean of the year, and, amongst the seasons, chiefly in winter, when a heavy sinking down of cooled air facilitates the effect of the rising of warm currents; in summer little is felt of it on the spurs stretching away to the southern borders.

II. Influence of great river systems and deep erosion.

The difference between the thermal conditions of High Asia and the Alps is much greater still, if we compare broad valleys. In the Alps, as in most mountainous regions of smaller elevation, the valleys are too warm in summer, too cold in winter; in High Asia the mighty extent of the river systems and their deep erosion has the effect, that places even in large, flat steps of the valleys, or in the centre of lacustrine basins now drained, are colder throughout the year than places situated at equal height on slopes and ridges.[1] This cooling effect of descending currents, by being kept together in the deep river-beds, is even felt in the plains along the southern foot of the Himálaya.

[1] Compare the stations: Kathmándu, in Nepál; Srináger, in Kashmír; Skárdo, in the valley of the Indus.

One would hardly suppose on first thoughts that stations in Hindostán or Bengál would attract attention by being *too cool;* only near the opening of large Hímalayan valleys some local reduction of the heat may be occasionally observed, but this too soon disappears at a little distance from the Himalayan tarái, in consequence of the regularity of the monsoons.

Nevertheless, when I came to compare larger surfaces, such as the region between the isothermal lines of 80° Fahr. to 75° Fahr., along the foot of the Himálaya (viz. from 80 to 87° Longitude East Green.), with the territories to the south, and also those to the west and east of it, I made the unexpected observation that the decrease of temperature in advancing towards the north is in fact much more rapid along the Himálaya; and I found in conclusion that the descending currents are the principal cause of it.

I am well aware that the more rapid decrease when compared with the regions to the south, where altogether the conditions of an isolated zone surrounding the thermal equator is somewhat exceptional, cannot be decisive; besides, also all over High Asia and to the north of it the decrease of heat with latitude is more rapid than it is in the central parts of India. But this must be kept in view, that in the Pănjáb, at a higher latitude than that of Hindostán, the decrease of temperature is much more in uniformity with that of Central India: whilst for the Pănjáb the neighbouring regions of the Himálaya next following are considerably less elevated, their cooling effect has to be applied to a much greater surface, and becomes in consequence nearly inappreciable.

Not so in Hindostán. The depression of the Ganges and Jámna river-beds, although broad at first, becomes narrowed between the Barér plateau and the Himalayan borders; here, if descending currents have any appreciable influence, they must be felt most distinctly. And indeed this perfectly coincides with the zone where all over India the isothermal lines show the most rapid decrease towards the north;[1] farther to the east, in the open jhíls and flats of the delta of the Ganges and Brahmapútra, the isothermal lines show a greater distance again, the cooling influence of Síkkim and Bhután becoming lost over the large surface it would have to cool.

[1] Also the Alps cause a light depression of the temperature of the Italian plains, as seen by a comparison with neighbouring regions not accessible to the influence of the Alps.

III. Modifications produced by height and extent of elevation.

The profile of the isothermal lines shows next a rise in its central parts, in Tíbet. This increase of temperature becomes more apparent still when we follow the lines to the northern margin of the profile through the Kuenlúen, where no ascending currents as powerful as those of the Indian plain exist.

Already for the Alps[1] I have had occasion to demonstrate the existence of an increase of temperature in the interior. For High Asia I did not fail to examine this result the more carefully, by the most various combinations in calculating the elements of the lines, as it had to decide whether in the Alps it is a local modification only, or to corroborate my having interpreted it there already as the consequence of any elevation of sufficient height and extent. My observations in Asia were the better for testing this as they were made in a zone so essentially differing in many respects from the Alps.

In reference to the heating influence of the quantity of solid substance, the effect became fully apparent as such, notwithstanding the great difference of latitude between the Indian and Turkish border of the profile; also the higher position of the sun in these latitudes increases the effect produced by a great surface of soil being exposed to insolation. In Tíbet heights up to 15,000 feet, in the very centre even to 18,000 feet, present themselves as included in the bendings of the curves.

In proportion to the dimension of the earth the elevation of any mountain-system is so small, that the change in the distance from the centre of the earth has no appreciable influence upon its temperature (15,000 feet would be $\frac{1}{1400}$ of the radius of the earth).[2] This is corroborated by the temperature actually observed in large mountain-systems where the lowest valleys do not descend below 8,000 to 9,000 feet. The decrease with height would be smaller still were not the loss by radiation so much increased here in consequence of the rarefaction of the atmosphere; this is one of the

[1] "Physical Geogr. of the Alps," Vol. I., pp. 378-380.

[2] According to Bessel, "Astronomische Nachrichten," 1841, Vol. 19, pp. 97-116, half the larger axis of the earth is 3272077·14 toises, half the smaller one 3261139·33.

principal reasons why such mountain systems also cause a loss in the final amount of heat produced by the sun upon the surface of the earth.[1]

Where, on the contrary, the ground is covered by an elevation not very high but very undulated, even the *absolute amount of heat* produced by insolation becomes greater than it would be on flat ground at a sea-level, as shown too by the stations of central India.[1]

In the tropics such modifications are felt much more distinctly than in higher latitudes; but it is not unimportant either for the increase of heat developed upon the total surface of the earth that most of the surface of the continents and islands is undulated, and that even in the higher mountain systems the quantity of substance raised compensates, partly at least, for the loss of heat by increase of radiation, contact with colder strata of the atmosphere, &c.

To complete the analysis of the profile of the isothermal lines I have to mention in reference to Turkistán, that there, too, the height of 3000 to 4000 feet of the basis connecting the Kuenlúen and the Sayanshán, being a broad, plateau-shaped valley of great extent, is somewhat too warm. At 4200 feet of height and 38° N. of latitude we have there a mean of the year little differing from 54° Fahr. Even adopting 420 feet for the increase of 1° Fahr., this would give 64° Fahr. when referred to the level of the sea, whilst the isothermal lines to the east and west of it could give but 59° or 60° Fahr.: an *increase* of temperature more than equivalent to the *decrease* we saw produced by the Himálaya along it south-eastern foot.

[1] A part of solar heat becomes absorbed in melting snow, but the surface covered by snow and ice is small even in the Alps, if compared to the total of the surface. I had obtained in the Alps about $1/_{65}$, snow and ice covering 55 to 60 geographical square miles upon a basis of 3500 to 4000. "Phys. Geogr. of the Alps," Vol. II., p. 509. Without entering here already into details for the Himálaya or Tibet, it is sufficient to remark, that in consequence of the lower latitude the glacial region there is much smaller still in proportion to the basis covered by all the mountain system.

[2] This could also be proved experimentally; in the lower latitude it became the more rapidly apparent, since insolation, and therefore also its alterations with the surrounding conditions, are objects so much more distinct. I observed it by exposing to the sun two stone plates equal in substance, colour, and weight, but the one flat, the other rough like a topographical model. The heat generated was compared by the effect they produced when plunged into two vessels containing the same quantity of water. In these experiments at Ambála, as well as in those about the daily variation of temperature, p. 54, Dr. Tritton kindly assisted me in every way.

[3] A detailed numeration of the conditions of decrease of temperature with height I have given in "Phys. Geogr. of the Alps," Vol. I., pp. 331-334.

The development of heat favoured by the configuration of the country in the central parts of High Asia appears therefore to become felt more towards the north; as to vertical propagation it seems to be but little traceable up the highest passes or very elevated peaks: following the predominating motion of the atmosphere, it is spread horizontally before becoming lost in the higher regions. The temperature of the air on isolated mountains of great height also in Tíbet we generally found to deviate but little from the mean values obtained now for High Asia in general, temperatures which must be considered at the same time as equivalent with those of the free atmosphere, considering the predominating of heavy winds at such heights.

THERMAL LIMITS OF PHYSICAL PHENOMENA, SNOW-LINE AND GLACIERS.

Physical geography presents many phenomena which, though not exclusively dependent upon temperature, show so decided a connection with it, that in order to complete the researches concerning its distribution in different provinces and at various heights, a comparison with at least some of the principal features has to be taken into analytical consideration.

Trees. The organism in vegetation, as well as in animal life, being an element of great variety, the influence of physical conditions becomes somewhat modified in different countries by the species met with, therefore a few data shall be quoted in reference to trees. The highest in the Himálaya are coniferous trees (not unlike those in our Alps): we met with them at a mean temperature of 45° Fahr., up to 11,800 feet. In Tíbet leaf-trees, and amongst them almost exclusively cultivated trees, even fruit trees, are the highest. As the highest group of cultivated trees—probably the highest leaf-trees of the globe—the poplar trees (*populus euphratica*) in the garden of the Mángnang monastery, 13,460 feet, must take the first place; the mean temperature of the year deduced from the isothermal profile is 37° Fahr. In the Alps trees like the cembras near Rofen[1] answer to an annual mean of 31° Fahr.

[1] For details see above, p. 475, note 3.

The limit of permanent habitation of men—so important for ethnography and national devolopment—is least comparable in reference to climate, since the fertility of the soil, and the social conditions, are not less powerful in modifying what we observe in different latitudes and at various heights. As to climate, the limits towards the poles show that in mountainous regions the mean temperature is not quite so low as it is towards the poles; but where absolute heights are so great as in many of the tropical and subtropical mountain-systems, the rarefaction of the atmosphere becomes another obstacle to human habitation.[1]

The snow-line. For comparison with temperature the snow-line is the most important of the physical phenomena; the conditions of its existence are less complicated, and in any mountain-system of sufficient height snow is met with; whilst a resulting formation of glaciers is affected much more at the same time by the topographical form of the country. The meteorological conditions of influence upon the snow-line are: the temperature and transparency of the air, the intensity of insolation, as well as the quantity and distribution of atmospheric moisture. The distribution therefore becomes so important, since summer rains, even up to great heights, materially contribute to reduce the accumulation of snow; the Himálaya, as also parts of the Alps in which summer rains prevail, show numerous instances of it. In the determination of the snow-line *slope* and *exposition* have to be taken into consideration. *Slope* shall be used here to designate at large all the depression descending on one or the other side of the principal crest. Also the *exposition*, most distinctly that to the north or to the south, is of inflnence upon the height of the snow-line. However, for comparing the mean values as we have to do it here, the details can remain unnoticed; the data were sufficiently numerous, and in taking the means the calculation was based upon data equally distributed. In the northern hemisphere the southern exposition causes

[1] In the outer ranges of the Himálaya, in consequence of topographical conditions, villages above 9000 feet are rare: in the interior they are found at 11,500 and 11,700 feet; mean of the year at this height 43° Fahr. In Tíbet the highest village permanently inhabited was Chúshul, in the province of Pangkóng, height 14,400 feet, the temperature resulting being 37° Fahr. The monastery Hánle, in Ládak, 15,117 feet, comparable in reference to its exceptional position and purpose with the monastery of the St. Bernhard, does not differ much in temperature, the mean being at the St. Bernhard, at an elevation of 8,114 feet, 30°·2 Fahr.; for Hánle even 36° Fahr. was obtained; but the atmospheric pressure, only 17½ inches at Hánle, is at least 22 inches on the St. Bernhard. For further details as to heights see Vol. II., pp. 473-481.

a rise, the northern a fall, of the snow-line, throughout, also in the Himálaya; only the *difference* between north and south, north-east, and south-west, &c., is not the same in every latitude.

When first the snow-line in the Himálaya was measured with precision, and the result obtained—now sufficiently proved—that the southern *slope* has the snow-line lower than the northern one[1] it met with many doubts and much opposition,[2] before this law was admitted for all the Himálayan chain. But now the analysis of the thermal conditions, which I was enabled to reduce for the first time to profiles of isothermal lines of the year and the seasons, not only showed that the isothermal lines for the year and the summer, which coincided with the snow-line for the year and the summer, are decidedly warmer on the southern (Indian) slope of the Himálaya than those on a level with the Tibetan snow-line;[3] also the further result was obtained, that in comparison with other zones of equal latitude, it is not the southern slope of the Himálaya which is the exceptional part in reference to the height and thermal conditions of the snow-line, but its northern slope and the other chains of Tíbet.

This was the more unexpected on account of the enormous precipitation known, at least from the sanitary stations at heights of 7000 to 8000 feet, for the outer ranges. However, for the snow limit it is to be kept in mind that at some distance from the Indian borders, and at heights greater than the average position of the sanitary stations, I found the quantity of rain already much reduced, even in Síkkim. The quantity of snow as we advance is also found to be nothing exceptional on the southern slope of the Himálaya, though its crest forms a sharp limit between this climate, comparatively moist, and that of exceptional dryness to the north of it.

The numerical data we have to take into consideration are the following.

[1] Details about the observers and the values obtained are given in Vol. II. of the "Results," pp. 496-500.

[2] Such as those of Capt. Hutton in McClelland's Journal, No. 14, 16, 19, 21, &c. The doubt was the more allowable as the heights at first were but estimated, even without sufficiently taking notice of the influence of the different seasons; see Humboldt, "Centralasien," Vol. II., pp. 177-215; "Cosmos," Vol. I., p. 44, and Col. R. Strachey, April 1849, Journ. As. Soc. of Bengál, XXIX., "On the Snow-line of the Himálaya."

[3] This short notice about it had been given already in Vol. II. of the "Results," p. 497.

Thermal condition and height of the snow-line:

1. *a.* Himálaya, southern slope or Indian side of the chain (latitude from Bhután to Kashmír, 27½° to 34½° N.), with an annual mean of the temperature of the air = 33° Fahr. . . . . 16,200 feet

1. *b.* Himálaya, northern slope, or Tibetan side, of the chain; annual mean temperature = 27° Fahr. . . . . 18,600 „

2. Karakorúm-chain in Tíbet, from Latitude North 28° to 36°, mean of both slopes; annual mean temperature = 25° Fahr. . . . . . 19,000 „

In the Karakorúm the *exposition* is of great influence. In northern exposition the snow limit generally is 18,600 feet; in southern exposition is reaches up in the mean to 19,600 feet, from determinations limited to Central and Western Tíbet, scarcely differing much from the snow limit in Eastern Tíbet either. Also the two *slopes* differ somewhat, that to the north having a lower limit of snow, but the difference near the crest is very small. Farther on to the north, a change in the precipitation becomes apparent in its influence upon the snow-line, since also in summer up to heights of 18,000 feet fresh snowfalls are sometimes observed; rain is of quite exceptional occurrence at all times.

3. Kuenlúen-chain, in its west-easterly direction only varying in latitude between 36° and 36½° N., *southern slope* facing the Karakorúm-chain, annual mean temperature = 26° Fahr. . . . 15,800 „

Northern slope, facing Turkistán, annual mean temp. = 26° Fahr. 15,100 „ [1]

[1] Farther to the west, in the Hindukúsh, lat. 35½° N., WOOD (in "Personal Narrative," &c., 1841, p. 365), when near the springs of the Oxus, found the snow limit = 13,000 feet, a height so low that at all events the amount of atmospheric precipitation must have considerable increased; even in Bálti the same effect is observed. In Hazóra, to the north-east of Naugáũ Lat., N. 35° 11′, Long. E. Green. 75° 5′, our brother ADOLPHE had found the snow limit to be only 15,600 feet. Though it was as late as end of September (1856), there was no reason to believe that the snow limit had sunk already that year, as neither rain in the valleys nor fresh snow on the slopes had been observed. At the same time the influence of exposition had now become the more apparent: in the northern exposition the height of the snow-line was 14,800 feet, in the southern exposition 16,400 feet; showing a difference of not less than 1,600 feet. This perfectly confirmed at the same time the supposition that that year fresh snow could have had nothing to do with the low "mean."

The variations seen in these combinations of temperature and height, in reference to the snow-line, can best be judged of if we compare them with data from other mountain-systems, especially with those from the Andes.

The snow-line was found in the northern hemisphere, in the Andes of Mexico,[1] Lat. N. 19° Fahr. . . . . 14,970 feet

In the southern hemisphere,[2] in the Andes of Quito . . . . 15,700 „

In the eastern Andes of Bolivia,[3] Lat. N. 14° to 16°; mean temp. = 34° to 35° Fahr. . . . . 15,900 „

In the western Andes of Bolivia, Lat. S. 16° to 18° . . . . 18,500 „

Some parts, as the environs of the Paachata, seem to present a general covering of snow only at 20,000 feet, just as the regions of the highest snow-limit in the Karakorúm.

In the Alps I had obtained with my brother ADOLPHE,[4] in a mean latitude of 46½° N., coinciding with an annual mean temp. = 24°·8 Fahr.:

For the southern slopes . . . . 9,200 „

For the northern slopes . . . . 9,100 „

The extremes in the environs of Mont Blanc and Monte Rosa reached 9,800 „

In Norway the respective values are, according to L. v. BUCH,[5] mean lat. 61° N., mean temp. = 24° Fahr. . . . . 5,240 to 5,590 „

For the Himálaya, therefore, on its Indian, or southern, slope, the snow-line is somewhat lower than would correspond to this latitude for Asia; but at the same time, the tropics[6] of America (the dry western

[1] HUMBOLDT, "Central Asien," 1847, Vol. II., p. 169. About the same height was found for it in Abysinia, by RUPPEL; "Reise in Abysinien," Vol. I., p. 414, Vol. II., p. 443.—These and the following data had to be taken over from the 2nd Vol. in order to be compared here with the conditions of temperature.

[2] Determined by HUMBOLDT and PENTLAND. HUMBOLDT, "Central Asien," Vol. II., pp. 165, 177, 213.

[3] HUMBOLDT, "Fragments de géologie et de climatologie Asiatique."

[4] SCHLAGINTWEIT, "Phys. Geogr. of the Alps," Vol. I., p. 379, Vol. II., p. 594.

[5] BUCH, in GILBERT'S Annal., XXV., p. 321.

[6] The tropical parts of India have no mountain-system high enough to have any snowy region. The mean annual temperature, in its coincidence with the snow limit from the equator to the arctic circle, sinks from 34·7° to 19·8° Fahr. The temperature to which the snow-line descends, we see, is not warmer in the higher latitudes, but in the tropics; the reason is that the absolute quantity of snow which falls and melts away again is greater in the tropics.

regions of Bolivia excepted) have the snow limit even lower still in regions less distant from the equator.[1] In reference to the annual mean temperature it must be kept in mind that, for the southern slope of the Himálaya it is altogether only about 1° Fahr. warmer than the calculation gives it for the globe all round in latitudes from 27½° to 34° N. But the more exceptional we must now find the limit of snow and the isothermal line corresponding to it on the Tibetan slope of the Himálaya and on the two slopes of the Karakorúm. In the rainless environs of the crest of the Karakorúm chain, though as far north as 35° to 36°, we found many places with a snow-line of fully 20,000 feet. The highest was here in the plateau-shaped environs of the Dápsang Peak, where the dominating summit reaches up to 28,278 feet, and is surrounded chiefly by bare rocks, and deserts without either névé beds or water.

In the Andes of America such unusual heights of the snow-line, wherever they are met with, are found limited to a much smaller extent; on an average the snow-line of the Karakorúm chain is that of *absolutely the greatest height*, but it is not yet that coinciding with the lowest temperature.

In the Kuenlúen the conditions of atmospheric moisture are no more the same. Precipitations in summer, also in the form of rain, are frequent enough, essentially contributing to diminish the quantity of snow remaining, and the total amount being not very great altogether, some 12 to 15 inches at the utmost, it so happens that here, in consequence of latitude, the snow reaches down to 15,100 or 15,800 feet, corresponding in the mean to isothermal lines of 26° Fahr.; but it also shows considerable oscillations, varying with the exposition, and coinciding frequently with isothermal lines of 23° to 25° Fahr.—a coincidence only met with again in Norway, at a latitude of 61° N. The farther we proceed to the east along the Kuenlúen crest

[1] Compare Durocher's "Calculations," Annal. de chim. et de phys., XIX., p. 1. He obtained the following repression (in mètres) of the snow-line for an additional minute of latitude,

Latitude	Depression	
0 — 10°	0·000 Mètres	0·000 Engl. feet.
10 — 20°	0·358 „	1·279 „
20 — 70°	1·173 „	3·848 „
70 — 74½°	3·259 „	10·691 „
74½ — 80°	0·857 „	2·812 „

Though essentially differing from many of the local observations in different countries, these numbers, correct enough for mean values, also show that in High Asia it is not the snow-line on the southern slope of the Himaláya which is the exceptional one.

the more this becomes *regularly* apparent.[1] For the tropical and subtropical zones therefore, the snow limit is there *absolutely the coldest* hitherto known—local irregularities of comparatively small extent in the Karakorúm and the Andes excepted.

In order the better to judge of these variations, the seasons too have to be examined, together with the isothermal lines corresponding to the respective periods.

The snow-line of a season is not so easily determined as that in the ordinary sense; local conditions are of greater and more irregular effect during the shorter periods. When, as usually, referred to the *annual period*, it is the lower limit of the regions covered by perpetual snow, where snow does not melt even during all the warmer period of the year. The *snow-line of the seasons* we may define as the lower limit of the region covered with snow 45 days out of the 91 days; or, which is about the same thing, we may say it to be the line to which snow reaches down in the middle of the respective season.

The means I obtained are the following:

Snow-line of the seasons, and its thermal conditions

Season.	Himálaya. Southern slope.		Himálaya. Northern slope.		Karakorúm. Mean.		Kuenlúen.[2] Mean.	
	Height.	Temp.	Height.	Temp.	Height.	Temp.	Height.	Temp.
Dec. to Febr.	9,000 feet	38° F.	8,500 feet	32° F.	8,000 feet	30° F.	6,500 feet	32° F.
March to May	12,500 „	40 „	14,000 „	35 „	15,000 „	32 „	12,000 „	40 „
June to Aug.	16,000 „	45 „	17,000 „	43 „	18,500 „	43 „	15,000[3] „	47 „
Sept. to Nov.	14,000 „	35 „	15,500 „	31 „	18,400 „	25 „	12,000 „	40 „

[1] The eastern part of the territories here examined is throughout cooler than the western part. For the fundamental lines compare the table given above, p. 445. Also by the vertical distance between the snow-line and the isothermal lines of the profile surrounding it this becomes very apparent here, that in an easterly direction along the crest of the Karakorúm or Kuenlúen the snow-line does not sink in the same measure as the isothermal lines.

[2] For the Kuenlúen the annual mean temperature corresponding to the snow limit (in the usual sense) may appear rather too cold when compared with the respective values of height and temperature in the four seasons; but it is easily understood that so it must be if we consider at the same time how rapidly temperature decreases with height, especially in winter.

[3] In this season the snow-line sinks with great rapidity towards the plains of Turkistán, varying from 15,000 to 10,000 feet.

The variation in height of the snow-line is smallest on the southern slope of the Himálaya; the other groups differ considerably as to the absolute heights, but *within* each group the variations as to the seasons are about the same for all three. Only in the Karakorúm the descent of the snow-line is less rapid, since the first storms with snow do not take place before late in autumn; and on the Yárkand road the principal pass, crossing the Karakorúm chain, 18,345, feet is passable for caravans with led horses and even camels during the whole year.[1]

Glaciers. The central profile in the meteorological plate for High Asia, also shows some of the lowest glaciers. Without entering here already into a thorough comparison of the glaciers of High Asia with those of the Alps, attention may be directed to one of the facts especially surprising to me. I found here the lowest glaciers reaching down—also in Tíbet, notwithstanding that the height of the snow-line there is so considerable—to isothermal lines much warmer than those near the end of the Bosson and Grindelwald glaciers in the Alps. These end at 43·7° Fahr.;[2] *in the Himálaya* the lowest[3] we know at present reaches down to 45°, *in Tíbet*[4] to 48° Fahr.—a temperature

[1] But little to the south of the crest also the passes of the Karakorúm mountain-system are impassable in winter when reaching up 16,500 to 17,000 feet. The Sásser pass, 17,752 feet, leading over extensive névés and glaciers, becomes regularly closed at the end of autumn. In 1856 we crossed it twice, and I had occasion to observe a decided alteration in the snow-line within the short period from the beginning of August to the middle of September; it was very useful for comparison that I had still with me the second time the panorama from August, now reproduced in Plate 9. The snow had already descended, in the higher parts of the view, several hundred feet, whilst the bas-névés filling up the lower ravines had continued to be reduced in size by melting. In winter the commercial road from Yárkand to Leh has to turn round the Sasser crest by following the valley of the Shayók. Amongst the roads crossing the Himalayan crest from Tíbet, in a southerly direction, none remains open all the year. Compare Vol. II., pp. 489-492.

[2] SCHLAGINTWEIT, "Physical Geography of the Alps," Vol. II., 512 to 518, and Plate XVIII. The Bosson glacier ends at 3,455 feet, that of Grindelwald at 3,290 feet. But these are by far the lowest, and very exceptional. The average height of the end of primary glaciers in the Alps is 6,000 feet at 33 to 34° Fahr.

With respect to the meteorological stations of the Alps named above, their coordinates and temperatures are:

	Lat. N.	Long. E. Gr.	Height.	Mean of the year.
Benedictbeuern........	47° 42′	11° 30′	2014 ft.	49·6° Fahr.
Freiburg	46° 48′	7° 10′	2078 „	48·7° „
Klagenfurt............	46° 37′	14° 19′	1438 „	48·2° „
Mittenwald	47° 27′	11° 15′	3069 „	49·1° „
Tegernsee	47° 30′	11° 32′	2399 „	47·8° „

The mean temperature at Greenwich—Lat. 51½°, height 156 ft.—is 48·9; 50° Fahr. is considered to be the general mean for our globe.

[3] The Cháia glacier, Lat. N. 31°, Long. E. Gr. 78½°, in Gărhvál, on the northern slope of the Cháia pass, the first pass between the Bhagirátti and Jămna valleys. "Results," Vol. II., p. 352.

[4] The Bépho glacier, 9,876 feet. It is situated near Áskoli, in Bálti, Lat. N. 35° 41′·3, Long. E. Gr. 75° 56′·0, height 9,710 feet, which is one of the highest villages in the Upper Braháldo valley. "Results," Vol. II., p. 462.

little differing from that of Benedictbeuern, Freiburg, Klagenfurt, Mittenwald, Tegernsee, in the Alps.

. The principal reason is, we shall see, that the extent of the névé beds of these glaciers is so much greater.[1] The depth to which glaciers descended in Europe during "the glacial period" was considered till recently exclusively as the effect of a sudden change in that gradual cooling of our globe which is shown by all the geological periods preceding. The free communication of the polar sea in the north of Asia with the foot of the hills of Central Europe, over plains then covered by seas, is certainly one of the reasons; the depression of temperature along the eastern shores of America when compared with the western coasts of Europe is an analogy still existing; but according to TYNDALL's theory a modification in the circulation of atmospheric steam has an important share in it too. Greater heat in general, and, if to be admitted for other reasons, FRANKLAND's addition of a temperature then comparatively higher in the northern seas, must have caused a greater amount of precipitation.[2] Where this fell in the form of snow, the extent of névé and glaciers must have been increased even during a period in which the average temperature of the atmosphere was higher than at present.

A similar condition still existing was discovered by F. v. HOCHSTETTER in New Zealand. On the southern side he found glaciers exceptionally reaching down to 500 feet, even in latitudes of only 43° to 44° degrees south; the average height of the ends of glaciers is 2,800 feet. Such low descent coincided there with a short distance from the sea, causing a great amount of snow-fall. Though he mentions that they must reach down to a warm temperature, he gives no numerical detail of isothermal lines or local temperature to be compared with these most interesting phenomena. From the maps of isothermal lines of the globe, as shown on a smaller scale in Number II. of the meteorological plates, the temperature at sea-level may be expected to be there 48°, even 50° Fahr.

In High Asia, however, the cause must be a quite different one. The descent in reference to temperature being lower than in Europe and in the Himálaya, as well as in Tíbet, and by far the lowest of High Asia even in the dry region of Tíbet, the extent

[1] Besides temperature, the inclination of the ground upon which a glacier rests may also have some influence, as detailed in researches in the Alps quoted above, Vol. II., p. 513. This element, however, is more potent in the Alps than in the Himaláya, and least in Tíbet.

[2] Mechanics' Magazine, Sept. 19, 1862; &c.

of the névé-beds must be looked for as the cause of it: the streaming together of ice from such large surfaces counterbalances the greater melting away lower down, where the temperature is already warmer. The extent of the larger Tibetan river-systems, even at great heights of the valleys, such as the Shayók in Núbra, the Indus and the Såtlej in Gnarikhórsum and Ladák, has an effect quite analogous and makes an impression not less unexpected when you first have to overcome the difficulties of crossing one of the streams in provinces where the annual amount of rain or snow is limited to a few inches.

Also those descending currents of air following in a peculiar modification the surface of glaciers down to their lowest end, which I first described in the Alps as "Gletscherwind,"[1] contribute to protect a glacier with the more power the greater the névé field at its upper end is.

Snowy regions, even where not directly connected with glaciers, allow one to recognise, wherever snow is accumulated, an effect upon the temperature of the air similar to that of glaciers. So we see in *all seasons*, that the decrease of temperature is somewhat accelerated wherever we approach from below the snow limit — an effect the more sure to be independent of local modifications as it is the same in heights so widely differing in winter and in summer.

As another climatological peculiarity I must add, that, as it appears, the Himalayan glaciers at present still differ little, if at all, from the greatest size they had in times past, no erratic phenomena being observed there. In Tíbet a detailed examination proved to me that the salt-lakes are decided vestiges of permanent alteration of climate;[2] nevertheless an alteration in the size of glaciers could not be traced with equal distinctness. Permanent reductions in size, if they exist there at all, could not be separated with positive certainty from those minor oscillations in which decrease has so much chance of being followed again by larger dimensions. And, indeed, a careful examination of the meteorological conditions[3] sufficiently

[1] Schlagintweit, "Physikalische Geographie der Alpen," Vol. I., pp. 366-370.

The glacial wind frequently exercises a great modification upon the daily variation of temperature by considerably cooling the hours of the afternoon and the first part of the night. Sea-breezes do the same, but usually on a much milder scale.

[2] See above, pp. 134-136 of this volume. The salt-lakes were fresh-water lakes before, and are now in a state of gradual dessication.

[3] See the *summer* clouds in the view of the Tsomagnalarí salt-lake, Plate 28 of the Atlas, and their explanation as the last marks of the contemporaneous tropical rainy season (p. 521).

shows how much precaution is necessary in forming conclusions; for even if fully admitting that precipitation had been greater in Tibet before the drying-up of the lakes had reached its present state, it is sufficient to consider that the precipitation may have been greater then in the form of rain to see that its effect upon the extent of ice may have been a very different one.

The present volume, although originally intended to include also the researches about atmospheric moisture, had to remain limited to climate and temperature—partly because I found that the description of provincial climate required various and delicate comparisons, partly because during the progress of the work new materials were obtained from Indian stations. They were included with the more care since the number and favourable distribution of good stations is a most important element for the science of meteorology as well as for connecting its laws with practical questions.

The final object of science is the discovery of general laws; practical results are obtained less when sought for as such, but they never fail to follow when science has become enriched by important additions; we may even call them to a certain degree accidental, as they depend but too often upon the coincidence of discoveries materially differing in their origin. For meteorology such a favourable period is beginning now; in this regard the use of the telegraph, mentioned above in connexion with *the probable changes of the weather*, must be alluded to again. The tropics have the greatest chance of early application on a large scale, as they show a great variety of climate in their provinces and at the same time the greatest regularity within their seasons. However, a thorough knowledge and careful sifting of the data to be chosen as leading conditions is not less important.

The next volume will offer many an occasion to show how far, the conditions of temperature being known, the modifications also of other atmospheric phenomena may be considered as defined; even if on their first appearance they make an impression upon the scientific traveller not less unexpected and powerful than the scenery of life and landscape.

END OF VOL. IV.

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B. LIST OF OBSERVERS AND ASSISTANTS.

The observers were chiefly medical officers. The initials could not be added for want of space; frequently, too, they were very indistinct in the manuscripts. Where several observers have the same family name, they are quoted separately. If more than one station is connected with the same observer, this is marked by an asterisk. The "Native Observers" in most cases were sub-assistant surgeons, and occasionally schoolmasters. In the Himálaya and to the north of it we had to erect most of the stations ourselves, and leave behind observers from our own people to continue the observations; these are put together separately as "Magnetic Establishment."

Wherever possible, the "observer's" name is quoted as the authority; occasionally, as frequently too in printed or in official papers, I had to limit myself to naming the "reporter."

[1] a) Alpine results compared; b) Beob. Manuscr.; c) Metr. Manuscr.; d) (Emil) Bhuddhism, and philolog. details.

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